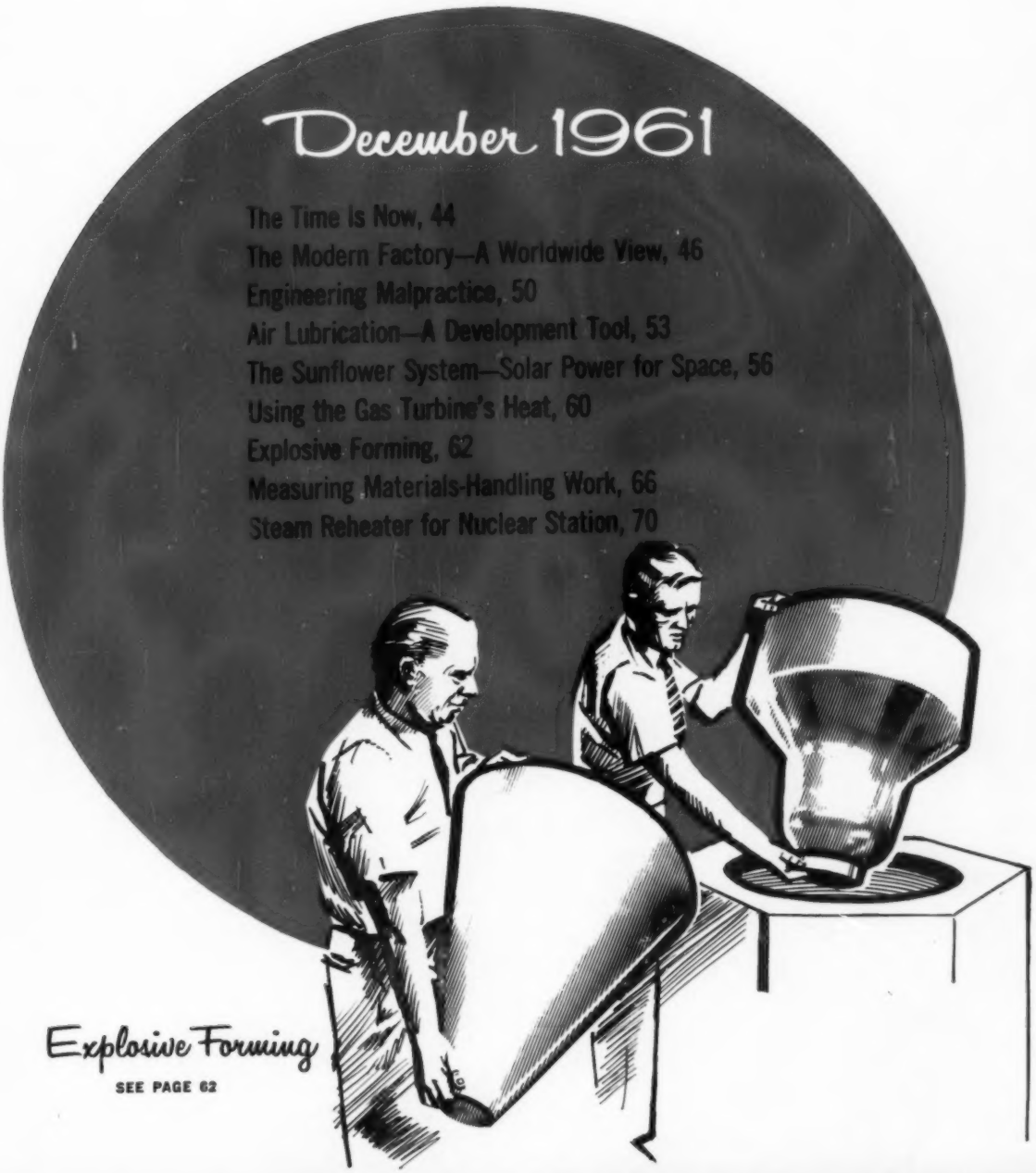
MECHANICAL ENGINEERING

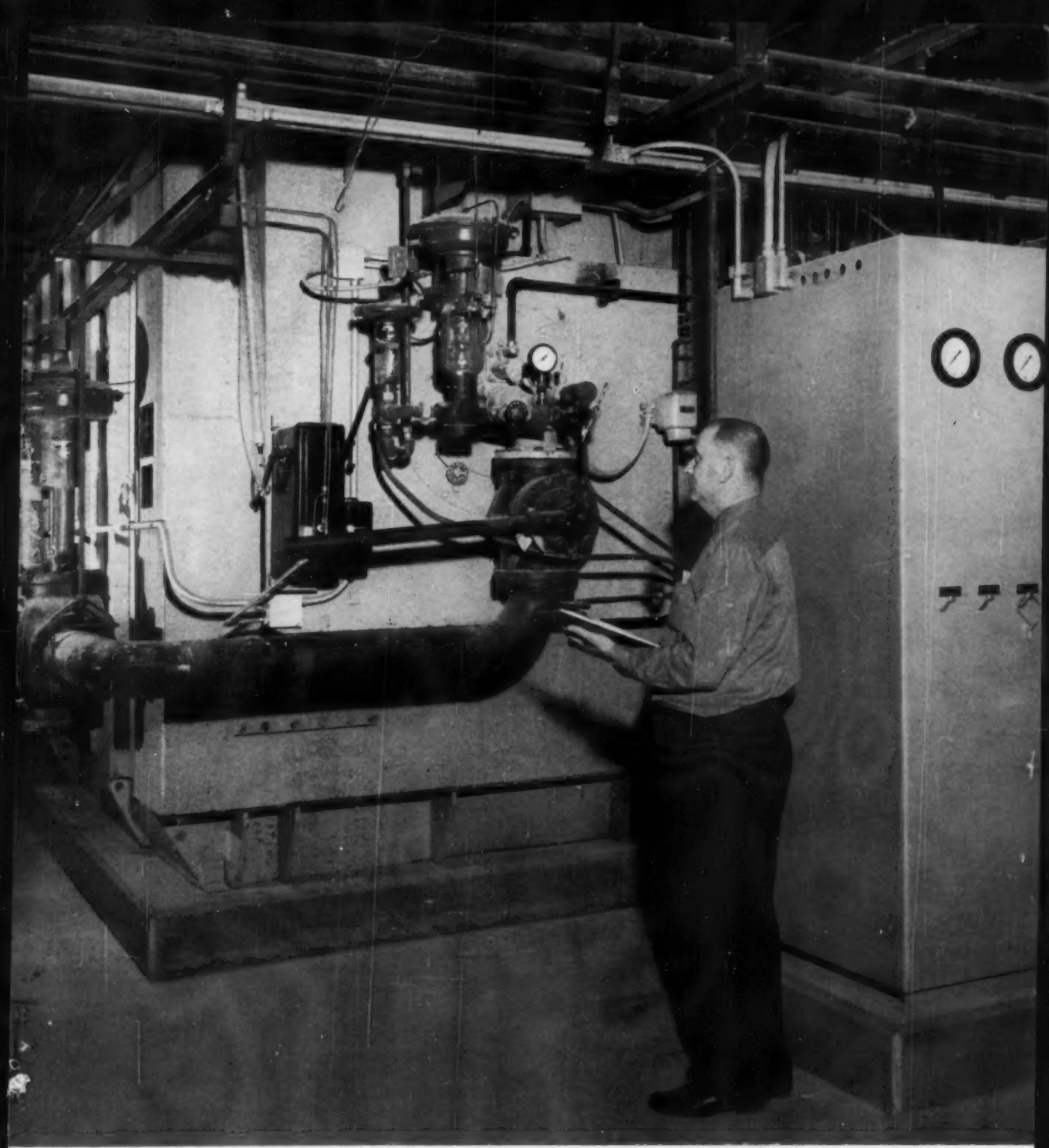
December 1961



Explosive Forming

SEE PAGE 62

Except for this plaque...



it's practically the same as 999 other B&W FM boilers.

The 1000th Babcock & Wilcox FM type boiler is now operating. It generates 20,000 lbs steam per hour at 250 psi and 353 F.

The FM is the most widely accepted and successful package boiler ever developed. In the eleven years since its introduction, the unit has produced heating and process steam economically and dependably in a great variety of installations.

The FM is a shop-assembled Integral Furnace Package Boiler available in capacities of 5,000 to 60,000 lb steam per hour, with pressures to 725 psi and temperatures to 750 F. The FM has automatically controlled oil or gas firing and is simple, safe and easy to operate.

When you need a boiler of assured dependability in the FM size range, contact your nearest B&W sales office or The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

Babcock & Wilcox

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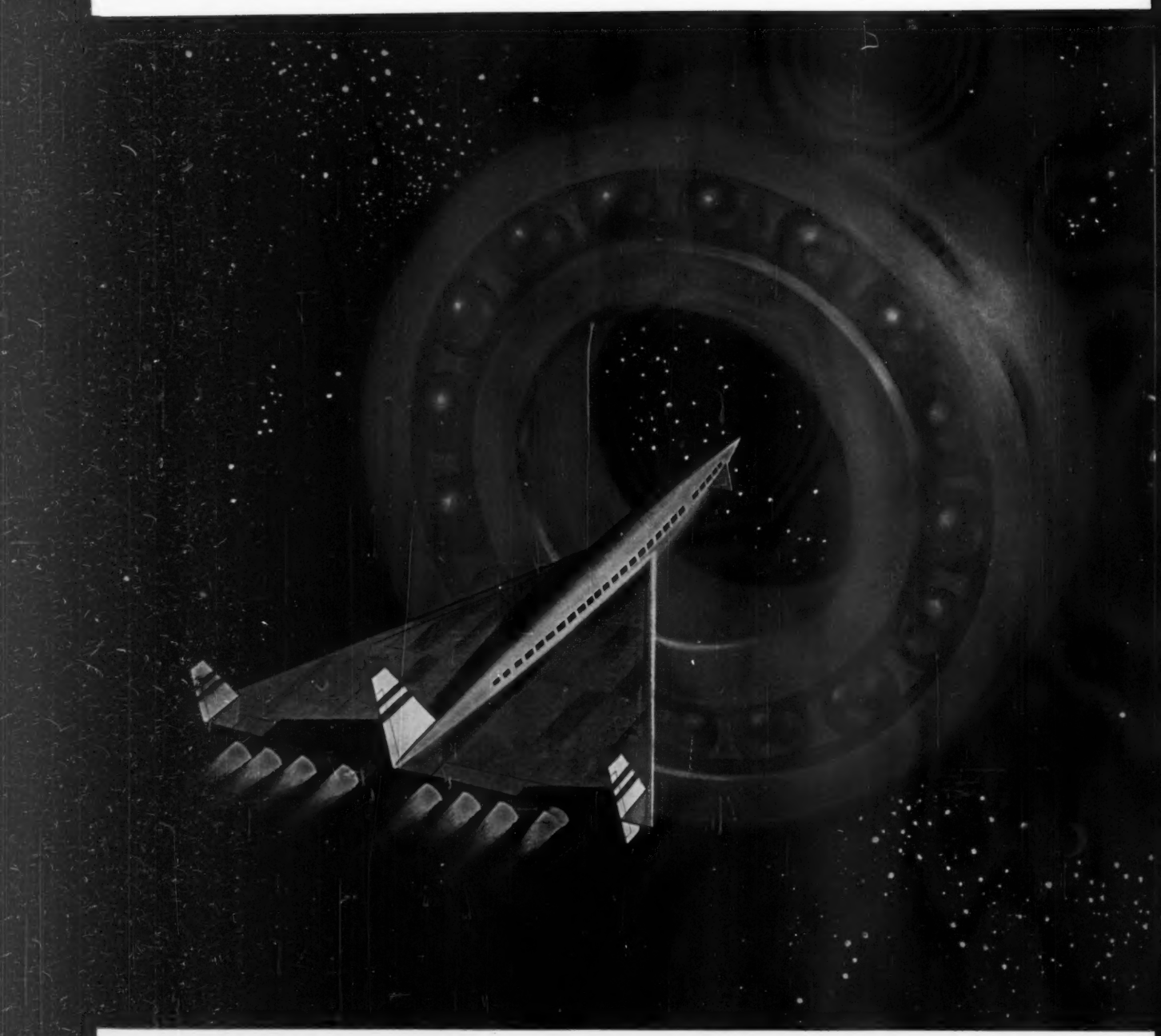

BEARING WITH A RED HOT FUTURE

SKF MOTION ENGINEERING

Advanced ball and roller bearing technology

On special test equipment in SKF's research laboratory, experimental ball and roller bearings are run at temperatures up to 1000° F and above—conditions under which steel becomes red hot and loses its strength, while conventional lubricants burn or boil away. To meet these problems, bearings made of special heat-resisting alloys and exotic new materials are tested and evaluated. New ideas in design and new approaches to lubrication are constantly being investigated.

Bearings to resist extremely high temperatures are needed for improved, high performance jet engines, gas turbines and other equipment. Special SKF bearings have been tested successfully in environments at about 1000° F. Under certain conditions of operation, much higher temperatures are practical.

Research like this is your assurance that SKF will always keep pace with demands for the highest possible performance in all major types of rolling contact bearings —ball, cylindrical roller, spherical roller, tapered roller and precision miniature. SKF Industries Inc., Philadelphia 32, Pa. 6103

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MECHANICAL ENGINEERING

PUBLISHED BY
THE AMERICAN SOCIETY OF
MECHANICAL ENGINEERS

Contents

VOLUME 83 • NUMBER 12 • DECEMBER, 1961

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MECHANICAL ENGINEERING

PUBLISHED BY THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Contents (continued)

VOLUME 83 • NUMBER 12 • DECEMBER, 1961

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There was never a time when *known* value was so important, when *extra* care was so necessary in buying components for welded piping systems. It is a time when you must make sure TUBE-TURN quality goes into your job, not merely into your specifications.

TUBE-TURN Distributors and responsible piping contractors are glad to give you this assurance. They are proud to provide affidavits on any job that they have met your specifications to the letter, affidavits in which they identify and describe whatever substitutes they supply within the "or equal" latitude allowed.

You get more of *everything* when you insist on TUBE-TURN welding fittings and flanges, the finest in product and service when you rely on the people who supply them regularly and are proud to prove it. Write for a copy of our new Bulletin 1031-M205. It's interesting and informative. TUBE TURNS, Louisville 1, Kentucky. "TUBE-TURN" and "tt" Reg. U.S. Pat. Off.

TUBE TURNS

Division of CHEMETRON *Corporation*

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More advanced engineering

More technical data to save mistakes

More responsible distributors

LIFESAVER For The Men Who Design Piping

Tube Turns offers not only the most complete line of properly engineered welding fittings and flanges for utmost flexibility in planning any piping installation, but a wealth of technical data and able engineering assistance without counterpart anywhere in the world. Standardizing on TUBE-TURN piping components saves time and trouble.

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The world's most complete line of welding fittings and flanges, over 12,000 regularly stocked TUBE-TURN items, permits every specification to be met without compromise or delay. A fully responsible Tube Turns Distributor is as near as your telephone to give prompt delivery of *all* your needs from *one* source on a *single* order. Saves time, paperwork, multiple checking, piecemeal deliveries and the inevitable problems of divided responsibility. You *save* money when you standardize on TUBE-TURN piping components!

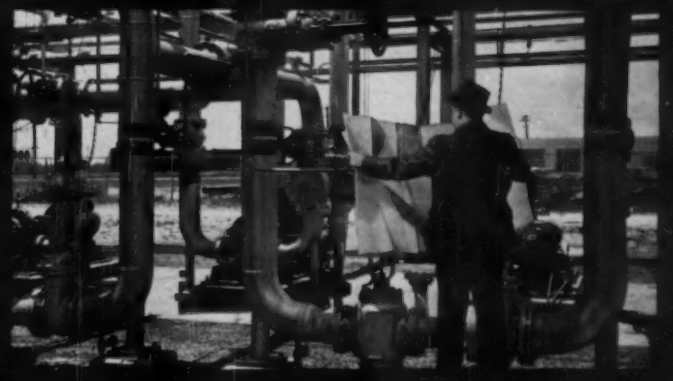
LIFESAVER For The Men Who Install Piping

Time is money in the assembly of a welding piping system. TUBE-TURN welding fittings and flanges do not require remanufacture or compromises . . . or the delays that result from rejections. They are uniform, precision-engineered for easy, time-saving installation. And you can put them in and *forget* them because they *are* dependable. TUBE-TURN piping components cost less because they save more in every way!

TUBE-TURN Welding Fittings And Flanges Are Stocked By And Sold Exclusively Through Authorized Distributors.

More service with less paperwork

More savings getting pipe installed



More dependability and satisfaction

Space fuel of the future—in production now!

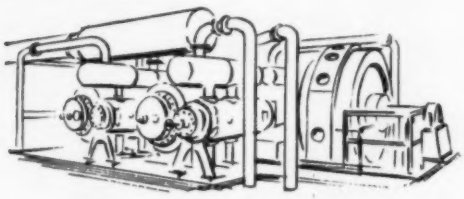
LIQUID HYDROGEN BY THE TON

99.9999% pure

Ingersoll-Rand HHE compressors help produce liquid hydrogen at world's first tonnage plant

Built and operated for the Air Research and Development Command by Air Products, Inc., U.S. Air Force Plant 74 is the world's first and largest unit for the tonnage production of pure liquid hydrogen. Here in the Florida Everglades, three Ingersoll-Rand HHE compressors are helping to produce one of the coldest substances known to man—for liquid hydrogen boils at 423°F below zero! It is also one of the most highly-purified substances known — estimated at between 99.9999 and 99.99999 percent pure!

With its high energy content and light weight, liquid hydrogen makes possible a family of super-powered chemical rockets and nuclear rockets with extremely advanced performance.



The hydrogen is produced from crude oil by partial oxidation, and is then compressed, purified and liquefied.

Used to compress three separate hydrogen streams, and also to create vacuum on nitrogen, are three identical Ingersoll-Rand HHE electric-driven compressors —among the largest such units built. These units provide the *stamina* and *versatility* so essential to sustained production at this new plant. Each HHE has three vacuum cylinders and nine compression cylinders, with the vacuum cylinders and three of the compressor cylinders operating in tandem. The HHE's unique flexibility of cylinder arrangement permits each unit to handle different gases at widely-different pressures and capacities, simplifying compressor plant layout and process-flow piping arrangements.

Ingersoll-Rand is best equipped to supply the compressor that's *right* for your job, too, because I-R builds the most complete line of compressors, in reciprocating, centrifugal, axial-flow, rotary and thermal types. There are units from ½ to 20,000 hp, for pressures from one micron to 125,000 psi. Your I-R representative can give you valuable help—call him today.

Ingersoll-Rand

278-A-1 11 Broadway, New York 4, N.Y.

THE WORLD'S MOST COMPREHENSIVE COMPRESSOR EXPERIENCE

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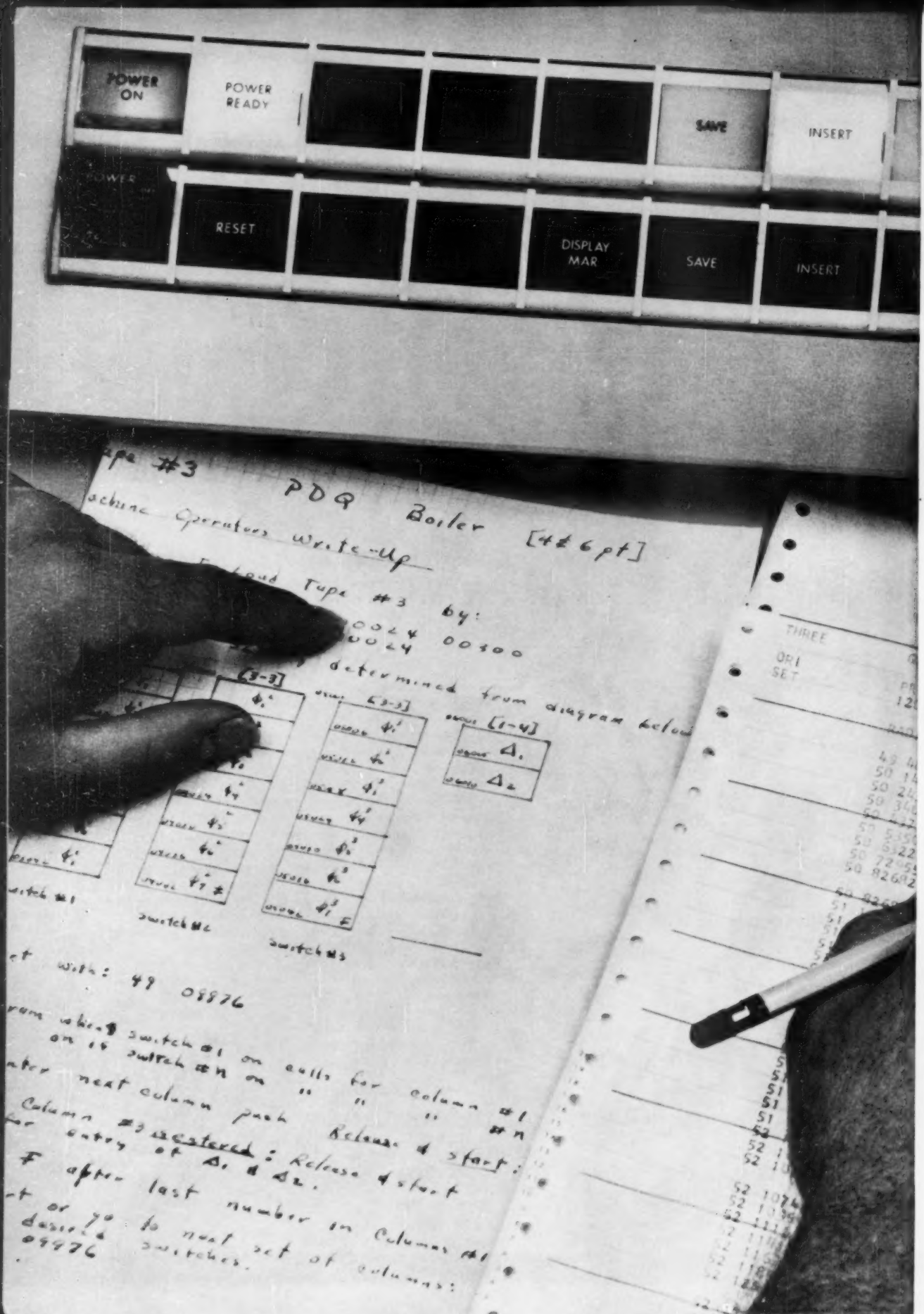
POWER ON
POWER READY
SAVE
INSERT
RESET
DISPLAY MAR
SAVE
INSERT
PDQ Boiler [4# 6pt]
Machine Operators Write-Up
switch #1
switch #2
switch #3
THREE
ORI
SET

Cost of one-dimensional criticality computations drops from an average of $75.00 to $7.50 per problem

Faster computing, less travel time are the reasons why General Nuclear Engineering Corporation has realized such cost savings since it installed an IBM 1620 Data Processing System at its Dunedin, Florida plant.

Since its main computing facilities are not located at Dunedin, General Nuclear has found that the new 1620 eliminates much of the travel time and expense involved in taking problems to off-site computers. In addition, the 1620 performs the simpler criticality computations 10 times faster than the computer previously used at one of General Nuclear's off-site data processing centers.

General Nuclear uses its new 1620 for other problems, too...heat transfer calculations, various transient codes, mathematical routines for the physics and engineering departments, multi-group calculations, and many other jobs you might expect only a much more expensive computer to be able to handle.

This isn't all. General Nuclear uses the 1620 to do statistical analyses and variance calculations on input data for programs run on off-site large-scale IBM computers.

For information on this highly versatile, low-cost data processing system, which rents for as little as $1600 a month, contact your local IBM Representative.

Easy to program. FORTRAN, IBM's scientific computer language is available for the 1620. General Nuclear scientists use a special scientific interpretive program—FIDO—written by the Manager of their Computing Section.

IBM®
DATA PROCESSING

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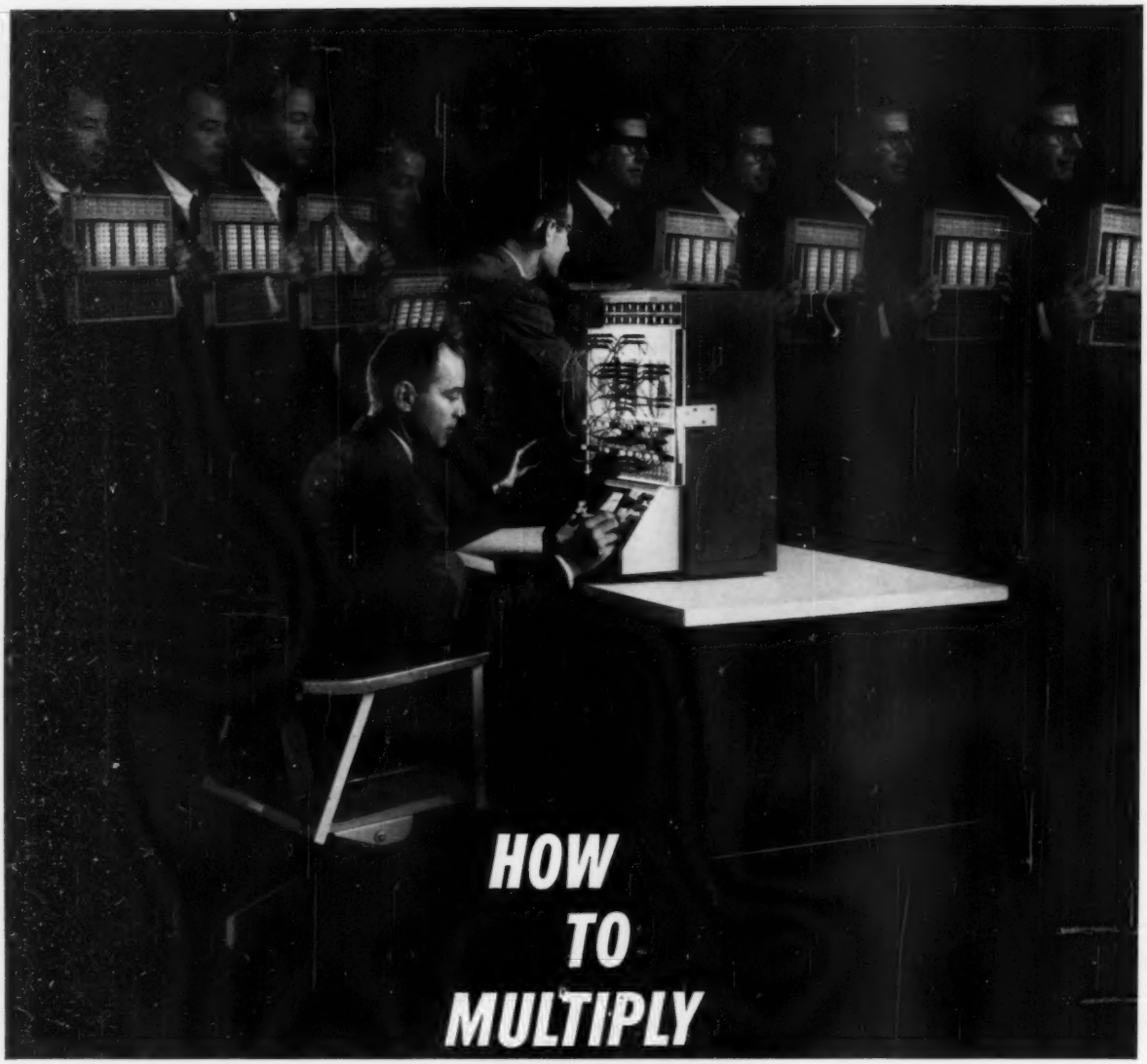

ENGINEERS

One engineer and an EAI PACE® TR-10 transistorized desktop analog computer can be the equal of several men limited to conventional design tools. The TR-10 multiplies the design capabilities of the most able engineer. One TR-10, equipped with a removable patch panel, will serve the needs of a roomful of engineers. This new patch panel permits pre-patching of programs away from the computer. It plugs into the computer instantly — valuable computation time is conserved. ■ *Versatility of the TR-10 is unequalled. Unique simplicity makes it excellent for students or engineers unfamiliar with analog techniques. Accurate to a tenth of one percent, the TR-10 performs admirably for the experienced user in 95% of routine engineering problems. And with High-Speed Repetitive Operation added, or with several units slaved to operate as one, the TR-10 meets the demands of many advanced applications.* ■ *For technical data on this almost infinitely versatile computer, write for Bulletin No. AC 934.*

Visit us at Booths 81, 82, 83 at Eastern Joint Computer Conference.

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Q. E. D.
DEPENDABILITY DEMONSTRATED

Now... basic characteristics of Metal Mold Centrifugal Casting contribute to the reliability of new Lacrosse Missile

THE ARMY'S LACROSSE MISSILE

U. S. Pipe supplies the barrel nozzle in a Cr-Mo-V low alloy steel analysis, heat treated to the following minimums: 95,000 psi tensile strength, 75,000 psi yield strength, and 10% elongation. This alloy is specifically designed to meet exacting military specifications. Various other analyses in carbon, alloy and stainless steel are produced.

Centrifugal casting, a direct production approach to quality, is now finding new and increasingly useful applications in rocketry and missile engineering.

U. S. Pipe, for example, supplies the alloy steel barrel nozzles for the Army's Lacrosse Missile as semi-finished, partially hot-forged lengths. These production pieces are being supplied to The Martin Company, Orlando, Florida — prime contractor for the Lacrosse, and to Parish Pressed Steel, Reading, Pennsylvania — subcontractor to The Martin Company. The contractors then finish machine them for assembly in the propulsion units.

Centrifugal casting offers ordnance design engineers several outstanding advantages:

1. **Versatility.** Many different alloy and stainless steel analyses, sizes and contours can be produced starting with a hollow billet.

2. **Dependability.** Years of experience in producing metal mold centrifugal castings assures high quality and reproducibility.

3. **Economy.** Maximum utilization of the *right* material produced with a minimum of processing to achieve overall efficiency.

Can these basic qualities meet the requirements and lower the cost of your material needs? Write today and outline your particular problem.

Size Range & Composition Flexibility
Outside Diameter—6" to 60" • Wall Thickness—⅜" and up
Length—Up to 25'
Types of Steel Cast, Carbon, Alloy and Stainless—all standard AISI and ACI grades.

UNITED STATES PIPE & FOUNDRY CO.

Steel and Tubes Division

STEEL & TUBES U.S. PIPE DIVISION

BURLINGTON, NEW JERSEY

SALES OFFICES: BURLINGTON, HARTFORD, BIRMINGHAM, CHICAGO, CLEVELAND, DALLAS, LOS ANGELES, NEW YORK, PITTSBURGH, SAN FRANCISCO

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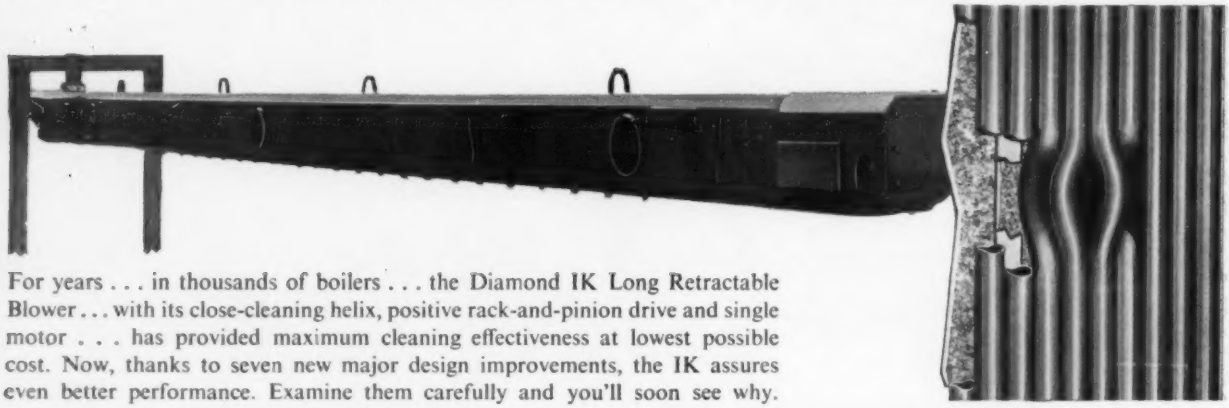
Diamond developed for more economical power...

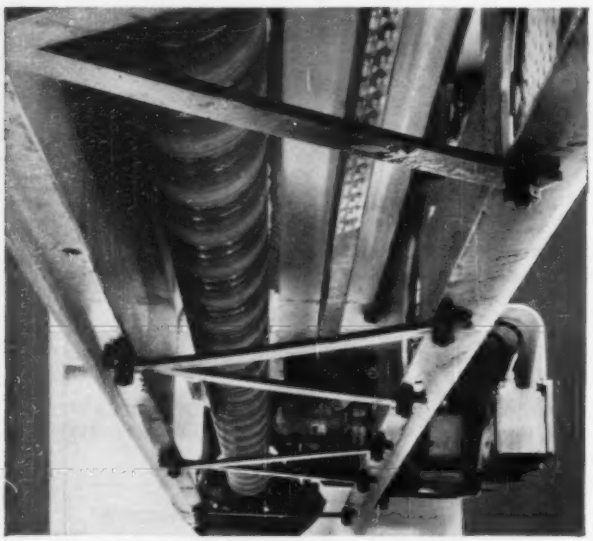
THE IK RETRACTABLE... NEW ASSURANCE OF BOILER CLEANING EFFICIENCY AND ECONOMY



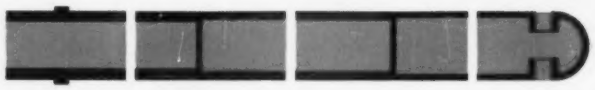
For years . . . in thousands of boilers . . . the Diamond IK Long Retractable Blower . . . with its close-cleaning helix, positive rack-and-pinion drive and single motor . . . has provided maximum cleaning effectiveness at lowest possible cost. Now, thanks to seven new major design improvements, the IK assures even better performance. Examine them carefully and you'll soon see why.

1 Minimizes valve leakage problems . . . flexible valve arrangement. In most valves, differentials in valve body temperatures produce distortion which causes leakage. In the new IK valve, this problem has been solved. Critical valve internals expand and contract *with* temperature changes, thereby eliminating distortion and drastically reducing the possibility of costly leakage.

2 Less stack emission by spaced blowing. More frequent but shorter cleaning cycles can be used in easy-to-clean zones. For any single cleaning cycle, this means a significant reduction in stack emission.



3 Ample coverage to clean the biggest boilers . . . box-type beam. For cleaning coverage over 34 feet, the Diamond IK Series 400 features a new box-type beam construction. This design retains the simplicity and convenience of two-point blower support with 6 inch trolley beam, yet assures ample strength and rigidity for stable, uniform lance travels to 42 feet and over. It also improves blower appearance and provides protection during installation. (Note: The evenly spaced roller marks on the retracted lance attest to the IK's exclusive "every inch" cleaning helix. It's your assurance of uniform, complete cleaning... *regardless* of tube bank arrangement and tube spacing.)



4 Reduced lance deflection and less wobble for longer travels . . . stronger lance. To minimize lance deflection where cleaning coverage is over 34 feet, Diamond uses a 3¼" O.D. lance instead of a 3½" O.D. lance. To further reduce lance deflection, the standard Diamond step-tapered lance tube construction is used. This rigid construction combined with the heavier lance support and box-type beam enclosure used on the Series 400 blower, assures stable lance travel and effective, uniform cleaning . . . for furnace coverage to 42 feet and over.

5 Multi-speed drives . . . less blowing medium . . . less cleaning time. A considerable reduction in cleaning cycle time with consequent reduction in blowing medium requirements (up to 25% savings) can be achieved through proper application of 2-speed electric motor drives.*

6 Mini-Lube . . . slashes need for maintenance manpower with once-a-year lubrication concept. To reduce costly blower lubrication, the number of lubrication points on the new IK has been cut from eighteen to only eleven. What's more, frequency of lubrication is greatly reduced . . . for instance, blowers operated three times daily should not require lubrication more than once a year. Figure it out! Mini-Lube can save thousands of dollars yearly in maintenance costs; helps keep your IK's in peak operating condition with minimum attention.

7 Insulated feed tube . . . reduced packing maintenance with steam blowing. A double-tube construction, with insulating air space between the two tubes, minimizes frequency of replacement of packing and shows significant savings compared with single-tube construction, for blowing steam temperatures of 750F and over.*

**Available at slight additional cost.*

For most effective cleaning of pendant and horizontal tube surfaces the Diamond IK Long Retractable Blower is your assurance of unmatched performance and economy. Call, write, or wire for complete information.

DIAMOND POWER

DIAMOND POWER SPECIALTY CORPORATION, Lancaster, Ohio
DIAMOND SPECIALTY LIMITED, Windsor, Ontario

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3	36	58	97	125	160
5	40	60	98	126	163
12	43	64	99	127	164
14	44	70	104	129	169
15	45	72	106	130	171
17	48	73	107	132	179
20	52	74	115	135	180
23	53	79	116	138	181
29	54	86	117	142	182
30	56	88	118	156	183

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K-2	K-11	K-20	K-29	K-38	K-47
K-3	K-12	K-21	K-30	K-39	K-48
K-4	K-13	K-22	K-31	K-40	K-49
K-5	K-14	K-23	K-32	K-41	K-50
K-6	K-15	K-24	K-33	K-42	K-51
K-7	K-16	K-25	K-34	K-43	
K-8	K-17	K-26	K-35	K-44	
K-9	K-18	K-27	K-36	K-45	

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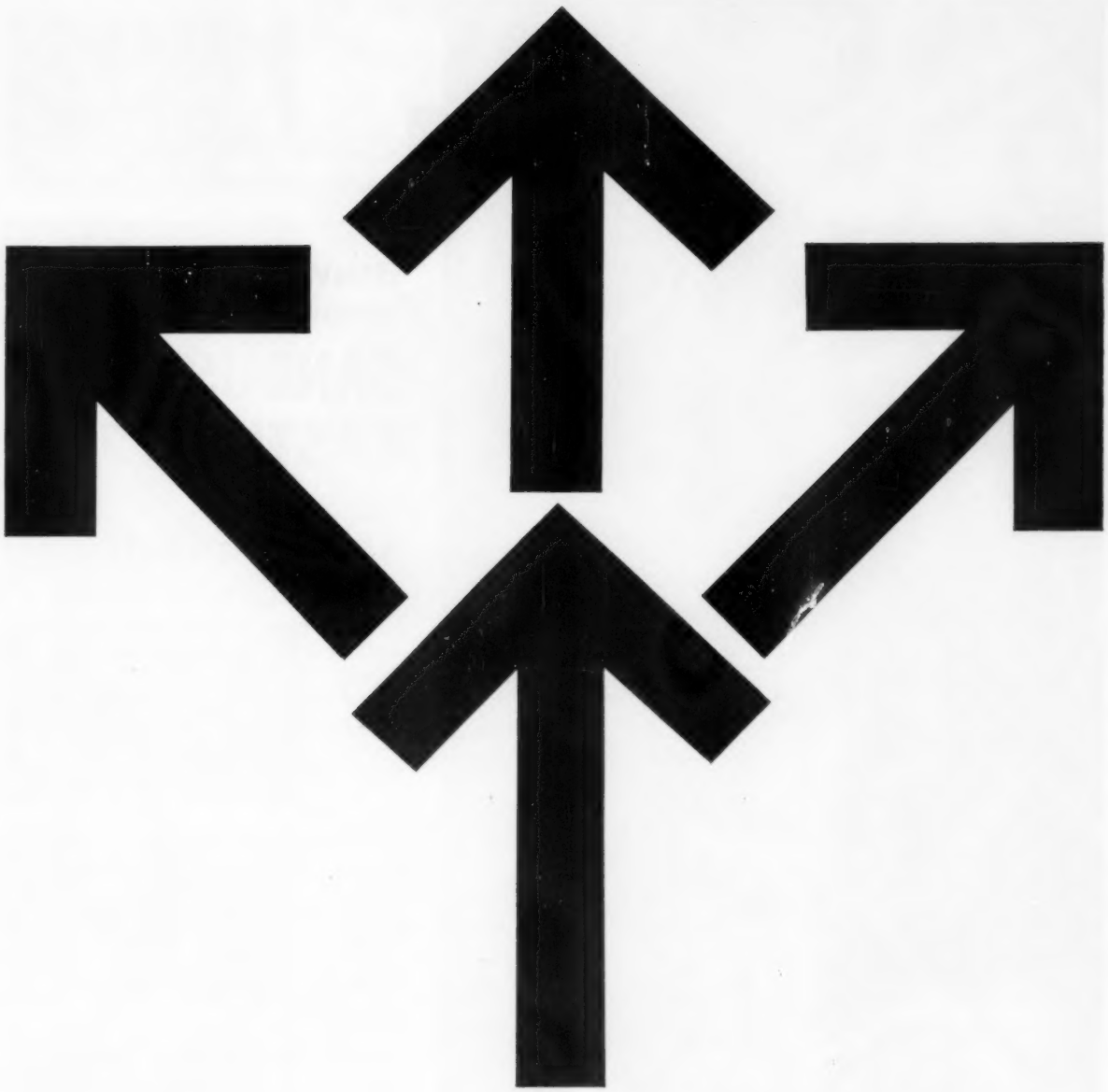


THE ORIGIN OF PROGRESS

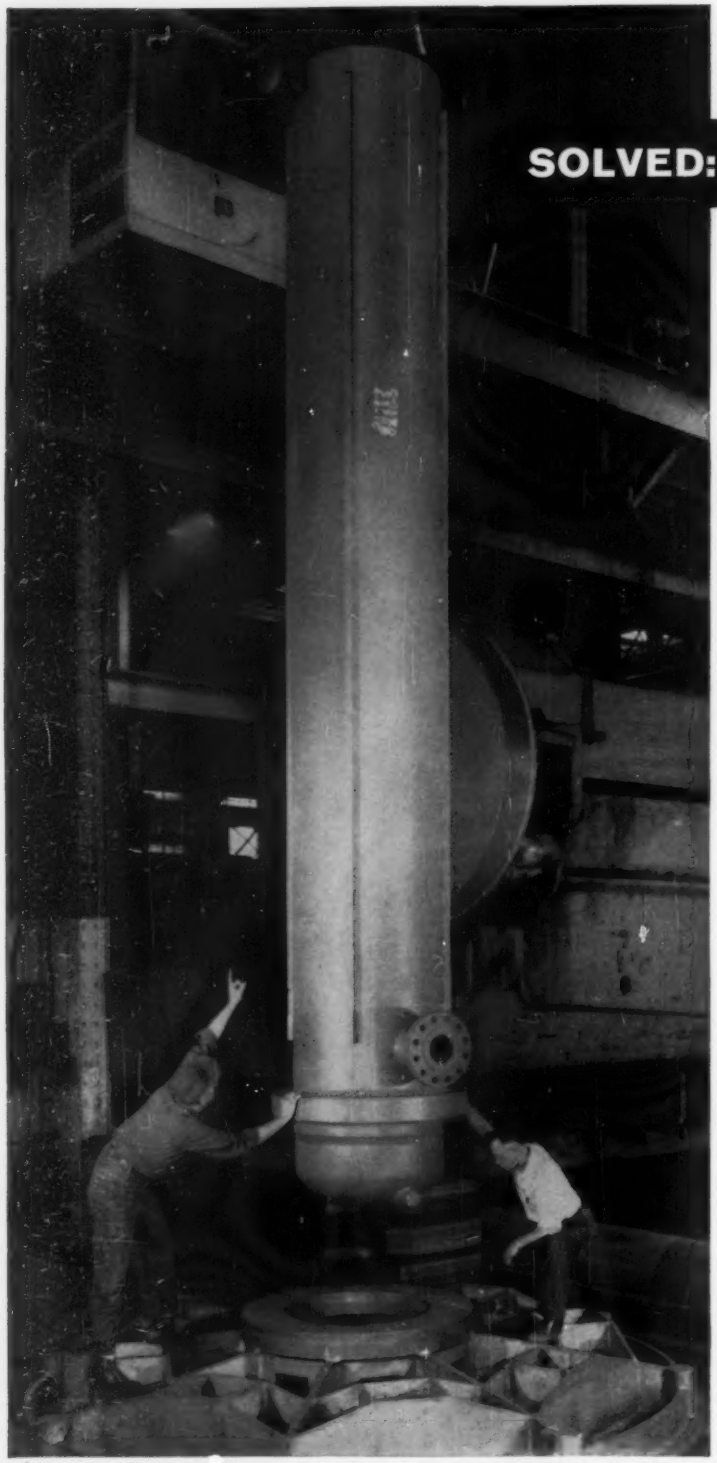
By William H. Byrne, President, The American Society of Mechanical Engineers

"Progress begins with progress. An improved component, a new material, a better process or procedure—all these are catalysts which spark progress in other fields. Learning about these new developments—through advertising—is vital to the men who engineer progress.

"Companies with a superior product—who know it will stand up to critical scrutiny by graduate engineers—find advertising an efficient way to tell their story. Engineers find advertising an invaluable source of information.

"Only in the advertising pages of MECHANICAL ENGINEERING do advertisers reach the 46,000 engineers who lead the way in mechanical engineering—the members of The American Society of Mechanical Engineers."

MECHANICAL ENGINEERING MAGAZINE, 345 E. 47th St., New York 17, N.Y.



Blaw-Knox workmen assembling one of two constant pressure type accumulators built for two of America's largest steel mills. Sandusky supplied the straight cylindrical sections for both.

SOLVED: by Sandusky Centrifugal Casting

Blaw-Knox chooses 10-ton

SANDUSKY CASTING

for giant slabbing mill

When an 18½-foot cylinder was needed for a new giant Universal slabbing mill built by Blaw-Knox Company's East Chicago (Indiana) Works for a well known steel mill, they found that the most practical and economical way to meet all requirements was with a Sandusky Centrifugal Casting.

This 10-ton carbon steel cylinder, 32" O.D. with a 3½" wall, functions as an accumulator in the mill's hydraulic roll balancing system. Essentially a pressure vessel, it simultaneously supports the ram and ballast weighing 226 tons—the weight required to develop constant operating pressure of 1000 p.s.i.

"Only a dimensionally stable, one-piece cylinder could perform satisfactorily in this service," a Blaw-Knox official asserted. *"Distortion could lead to binding, loss of pressure and costly downtime. Sandusky's ability to produce this heavy walled cylinder in one 18½ foot length met all our requirements of cost, stability, and strength."*

Sandusky cylinders up to 33 feet long —from 7" to 54" O.D.— and in a wide range of ferrous and non-ferrous alloys —may well be the answer to *your cylindrical problems,* too.

Write to us at Sandusky, Ohio. Ask for latest Bulletin #5901.

SANDUSKY ® **CENTRIFUGAL CASTINGS**

FOUNDRY & MACHINE CO.

5901

SANDUSKY, OHIO—Stainless, Carbon, Low-Alloy Steels—Full Range Copper-Base, Nickel-Base Alloys

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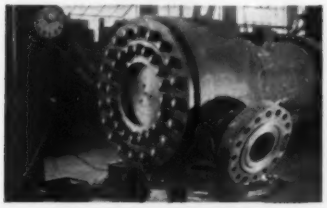
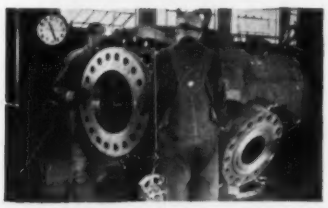
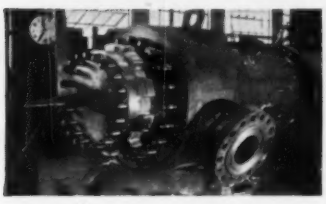
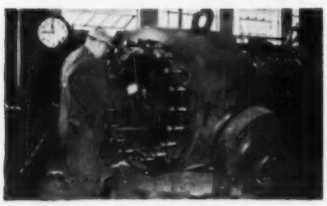
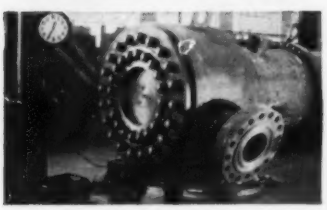


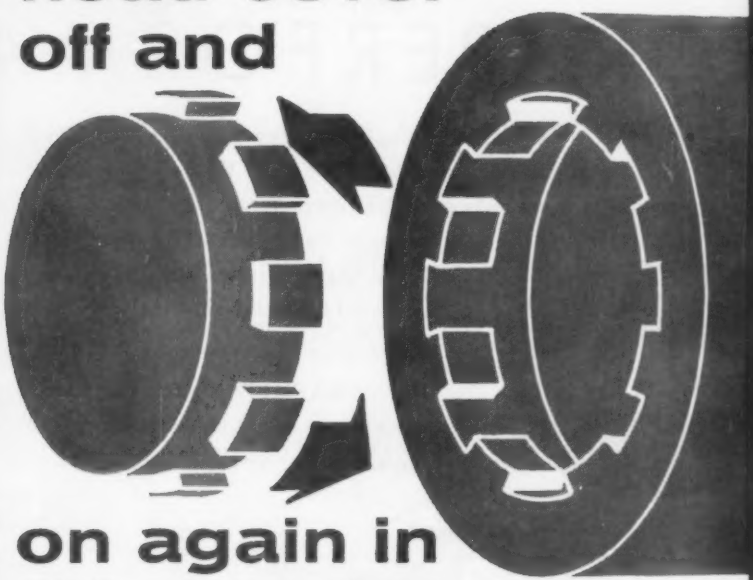








head cover off and



on again in 84 minutes

cuts feedwater heater inspection downtime

Periodic internal inspection of high pressure feedwater heaters is easy and fast with G-R Type "L" breech block heads. The complete operation of cover removal and reinstallation is shown in photographs at left.

When the cover is removed the entire tube sheet and all tube joints are readily accessible for examination and cleaning from outside the heater. No need to squeeze and squirm inside the water head whether heaters are large or small.

G-R Type "L" breech block high pressure heaters are available with all welded seals without gaskets, with rolled or rolled-and-welded tube joints.

More than 1,000 G-R heaters are installed operating at over 1,000 psi. More than 250 are in operation at pressures in excess of 3,000 psi. *This record is unsurpassed by any other American manufacturer.*

G-R high pressure heaters are available in all types and sizes, horizontal or vertical, and are furnished with suitable cover handling rigs.

Take advantage of G-R's extensive experience in the design and fabrication of Feedwater Heaters. There is a G-R representative in your territory ready to help you.

GRISCOM-RUSSELL / C. H. WHEELER

Massillon, Ohio — Philadelphia 32, Pa.

Affiliated sources for heat exchangers, closed feedwater heaters, deaerating heaters, evaporators, steam condensers, pumps, marine auxiliary equipment, sea water distillation plants, nuclear steam generators and related components.

Circle No. 135 on Readers' Service Card

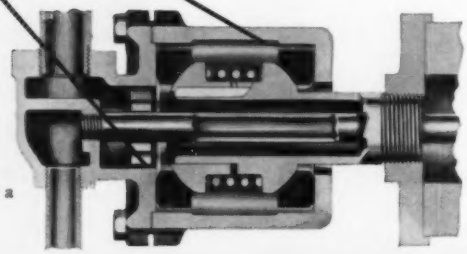
GRAPHITAR®

(CARBON-GRAPHITE)

FOR PERFORMANCE

Superior performance and unusually long service life, even in tough applications, is practically second nature to parts made of GRAPHITAR. That's because they combine GRAPHITAR's chemical stability, heat resistance, low coefficient of friction, adaptability to self-lubrication, mechanical strength, hardness and light weight. An everyday application of GRAPHITAR that illustrates well its versatility and remarkable performance can be found in the face-type valves employed in bulk station gasoline meters. These valves incorporate GRAPHITAR seats.

Here, GRAPHITAR's corrosion resistance, chemical inertness and resistance to expansion or contraction under rapid temperature changes, allow the valves to provide a leak-tight seal with excellent wear characteristics. These same characteristics are necessary for good performance wherever steam, gas and chemicals must be handled under the most adverse conditions. Perhaps your product can benefit from the top performance of GRAPHITAR, a unique and versatile engineering material.



Self-aligning seals of GRAPHITAR are employed in rotary pressure joints handling steam, water, hot oil, trichlorethylene, powdered talc and a variety of chemicals.

R-302-1

Comparative testing of various grades of GRAPHITAR self-aligning seals is accomplished on this equipment, which duplicates actual operating conditions. GRAPHITAR rotary pressure joint seals such as these often operate at 400 psi, at 650°F. and at rotary speeds of 600 ft/min.

GRAPHITAR is a material uniquely designed by its nature for solving tough problems and improving processing, and it can be further custom-engineered to meet your exact specifications. For complete information on GRAPHITAR . . . send for Engineering Bulletin #20.

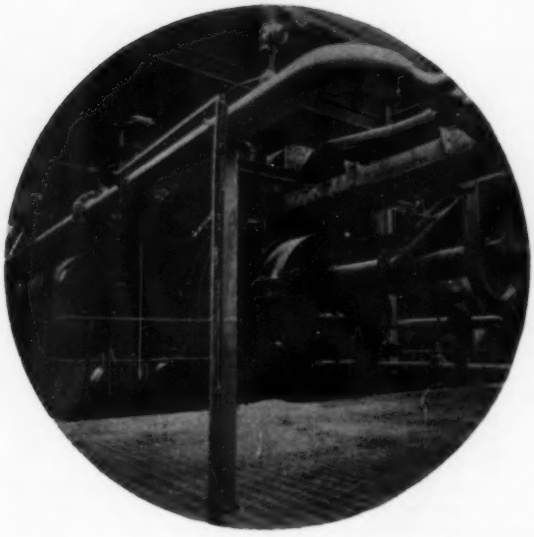
THE UNITED STATES GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW 4, MICHIGAN

GRAPHITAR® CARBON-GRAPHITE • GRAMIX® POWDER METALLURGY • MEXICAN® GRAPHITE PRODUCTS • USG® BRUSHES

Circle No. 129 on Readers' Service Card

500 tons of process piping...



Fabricated and erected by Midwest for Kaiser Aluminum's Baton Rouge plant

For this alumina processing plant of Kaiser Aluminum & Chemical Corporation in Baton Rouge, more than 500 tons (1,550 pieces) of piping were fabricated at the Midwest plant and erected by a Midwest field crew of 250. Midwest also installed slurry pumps, desilicators, monohydrate digesters, flash tanks, liquor heaters, storage tanks and other equipment.

Midwest's practical experience, complete facilities and skilled personnel—in the plant and in the field—can serve you efficiently and economically, whether you need a single fabricated assembly or an entire piping job for your plant or its power station.

Write today for 24-page illustrated brochure POWER AND PROCESS PIPING, describing Midwest's capabilities in the fabrication and erection of piping. Includes numerous case histories on piping projects of all sizes and types.

MIDWEST PIPING

A DIVISION OF CRANE CO.

1450 South Second St. • St. Louis 4, Missouri

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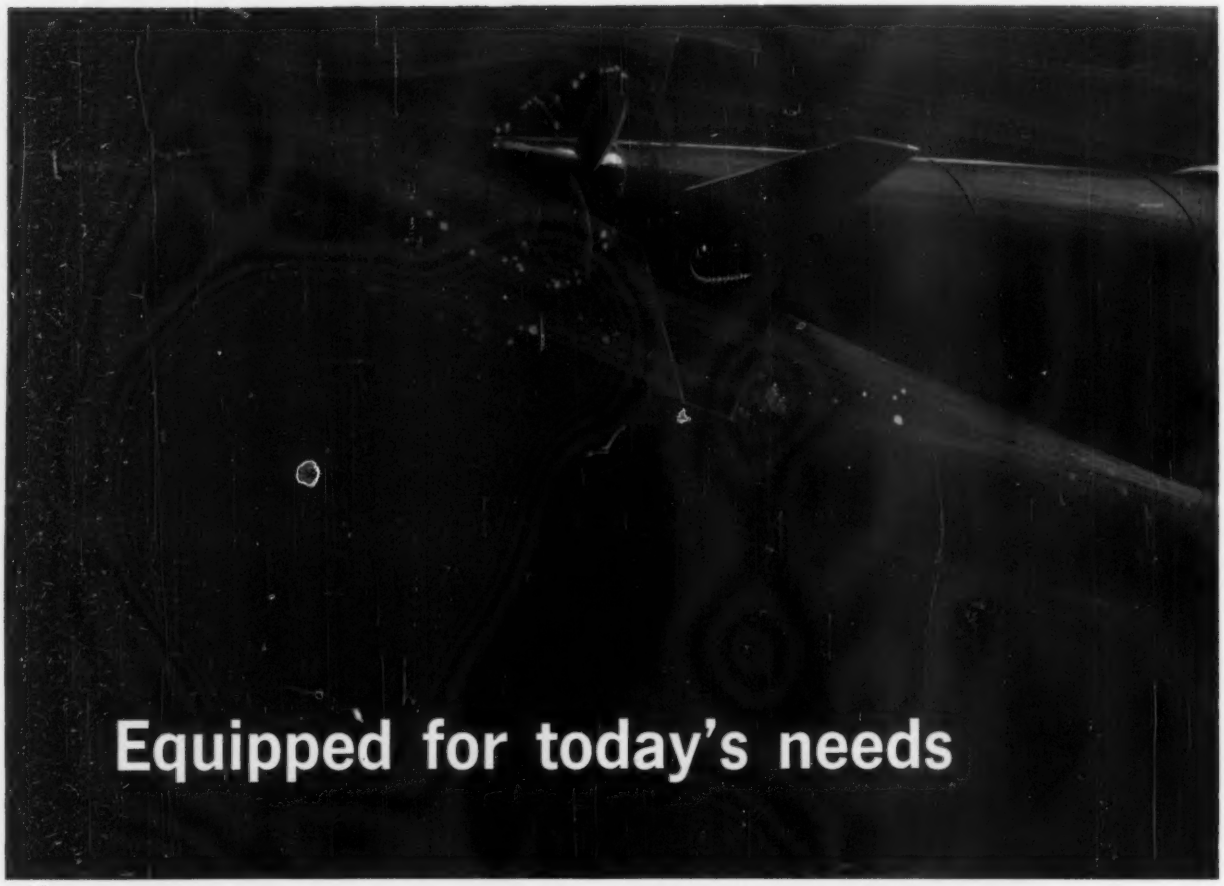
Circle No. 98 on Readers' Service Card



Sheffield is a consistent supplier of steels for many of America's newest submarines and ships.

Now Sheffield is the source for a complete line of heat treated carbon and alloy steels!

New Sheffield Houston installations mark a new era for many industries served from the Southwest.

Today Sheffield is the most *complete* source of heat treated carbon and alloy steels in the Southwest. Recently installed, new 160" heat treating equipment can handle wider and heavier plates which will be rolled in the Sheffield Houston plant's new 160-inch combination slab and plate mill—soon to be finished. This is the only equipment of its kind in the Southwest, and the most flexible anywhere. It is designed for quenching, tempering, normalizing and isothermal annealing carbon and alloy plates.

Heat treated bars to exacting requirements

Also available is the newest in heat treating facilities for bars. It is a precison mechanized and instrumented operation to maintain close control of time and temperature necessary for uniform physical and mechanical properties. It is capable of oil or water quenching, tempering, normalizing, annealing and stress relieving.

SHEFFIELD
Heat Treated Carbon and Alloy Steels

GRADES

All standard AISI alloy steels and many special steels such as HY-80 (armor plate for Naval application such as in the new nuclear submarines.)

SIZES

Bars, Rounds—⅜" to 8⅜" in diameter, 40' in length.
Flats—1½" to 8" in width, 40' in length.
Round Cornered Squares—Up to 6" x 6" section.

Plates*—3/16" through 2" thick
Widths to 120 inches
Lengths to 45 feet

**Special Note: After the new 160" plate mill is completed in 1962, Sheffield will be able to furnish plates up to 144" wide and 4" thick.*

Newest wide plate heat treating equipment in the industry. This recent installation is in Sheffield's Houston Plant. It's the most flexible anywhere in the world.

Add strength . . . subtract weight with new Sheffield SSS-100!

This new, quenched and tempered alloy constructional steel offers greater durability under punishing loads . . . plus excellent weldability. Now you can design with lighter components and not sacrifice strength. These qualities make SSS-100 and SSS-100A ideal for bridges, earth-moving machinery, transport equipment, missile ground-support equipment, TV towers—any job that calls for high strength and toughness.

New Sheffield SSS-100

Tensile Strength	115,000 psi minimum
Yield Strength	100,000 psi minimum
Elongation (in 2 inches) . . .	18% minimum
Reduction in Area	50% minimum

SSS-100 may be furnished to requirements of ASTM A-300 at −50°F in firebox or higher quality levels.

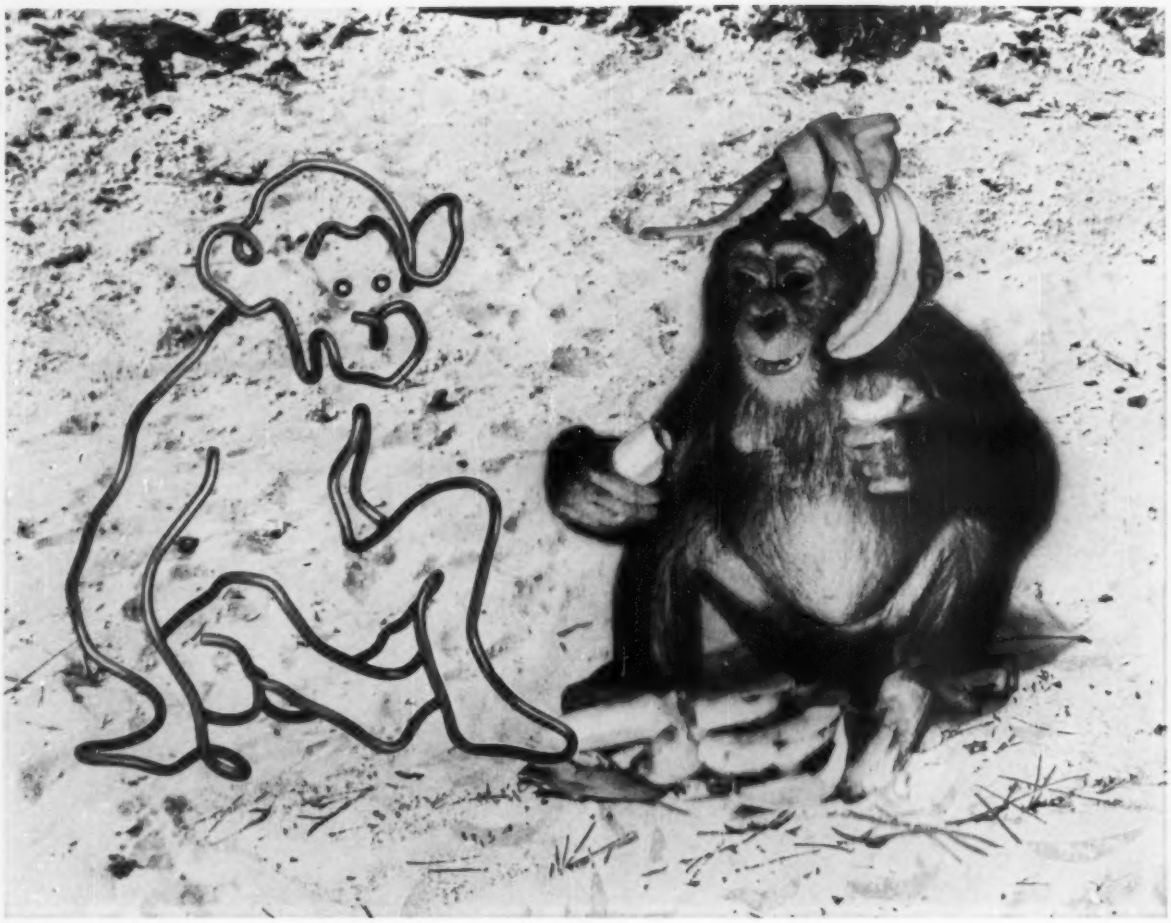
ASME Approved

SSS-100 is approved for use in the construction of welded pressure vessels according to the requirements of Section VIII of the ASME Boiler & Pressure Vessel Code (Case No. 1298—Special Ruling).

For technical details or assistance write **Sheffield Division, Armco Steel Corporation, Attention Alloy Sales, P. O. Box 3129, Houston 1, Texas.**

ARMCO Sheffield Division

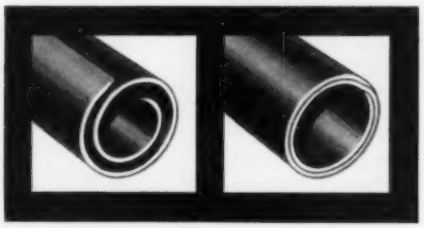
Circle No. 159 on Readers' Service Card



Bundy can mass-fabricate practically anything

Bundy engineering and design specialists thrive on *your* tubing problems. Backed by years and years of experience, they can often come up with more efficient methods for mass-fabrication of tubing components—incorporating the best design ideas and the best steel tubing ever. With Bundyweld® steel tubing you can make more different complex bends and shapes. And Bundyweld meets Government Specifications MIL-T-3520, Type III; ASTM 254; and SAE specifications. For answers to *any* tubing problem, call, wire, write: Bundy Tubing Company, Detroit 14, Mich.

* * *



Bundyweld, double-walled from a single copper-plated steel strip, is metallurgically bonded through 360° of wall contact. It is lightweight, uniformly smooth and easily fabricated . . . has remarkably high bursting and fatigue strength. Sizes up to ⅝" O.D.

BUNDY® TUBING COMPANY

DETROIT 14, MICH. • WINCHESTER, KY. • HOMETOWN, PA.

WORLD'S LARGEST PRODUCER OF SMALL-DIAMETER TUBING. AFFILIATED PLANTS IN AUSTRALIA, BRAZIL, ENGLAND, FRANCE, GERMANY, ITALY, JAPAN.

Circle No. 29 on Readers' Service Card

STANDARD ROLLER CHAINS

ACME chains are available in sizes from ¼" pitch, ⅛" width to 2½" pitch, 1½" width.

MULTIPLE ROLLER CHAINS

Multiple roller chains of double, triple and quadruple widths in all standard pitches in riveted types are ordinarily carried in stock — multiple chains up to 6 strands or wider can be furnished.

There's an

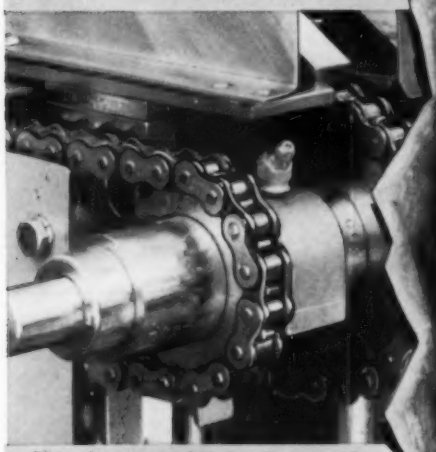
ACME ROLLER CHAIN

for every

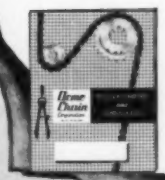
POWER TRANSMISSION REQUIREMENT

ACME Roller Chains are designed and built to perform each specific job with maximum efficiency and economy. Sprocket ratio, chain impact, tension, drive speed and other factors are determined, not on the drawing board alone, but in the field where ACME Engineers observe and test chains at work while new equipment is being designed. In that way, ACME chains are made to deliver positive power transmission with economy and dependability under all loads at all times.

For maximum performance at low transmission cost, be sure to specify ACME Roller Chains. They will give you the most value for your chain money. Call your ACME Distributor.

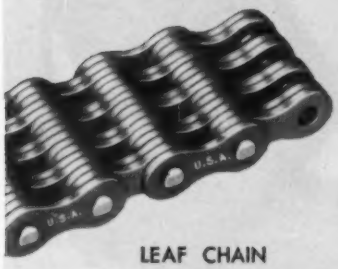


This shows a typical installation with positive power transmission where long life is essential.



Write Dept. 11-R for new illustrated 106 page catalog with engineering section.

Acme Chain Corporation
Holyoke
Massachusetts



LEAF CHAIN

These are furnished in a variety of pitches, widths and strengths to suit different applications.

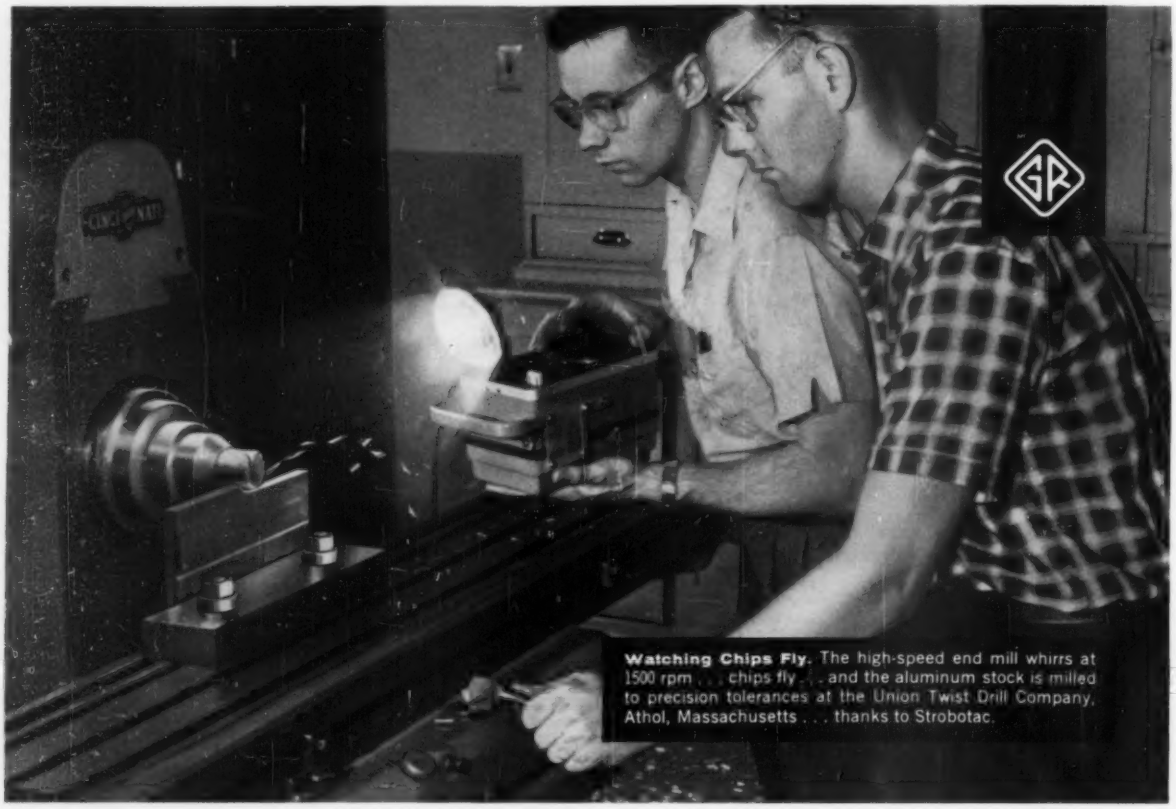
OFFSET CHAIN

Offset Side Bar Chains for drives that require herculean strength in construction machinery and oil fields.

EXTENDED PITCH CHAIN

Extended pitch chains are becoming increasingly more popular in many industries where high grade finished roller chains are required, at a lower cost than the standard pitch chains.

Circle No. 1 on Readers' Service Card



Watching Chips Fly. The high-speed end mill whirrs at 1500 rpm . . . chips fly . . . and the aluminum stock is milled to precision tolerances at the Union Twist Drill Company, Athol, Massachusetts . . . thanks to Strobotac.

Research with STROBOTAC

The new, white-light Strobotac is an important tool for studying the effect of geometry variations in cutting tools. Chip flow can readily be observed. "Stopping" the cutter with Strobotac enables a previously impossible view of the chip tool interface. If the chips are tearing from the milled surface, or are scraping the smooth surface in their escape, the prototype tool is redesigned to promote proper chip flow.

This is but one of the many uses for the Strobotac in dynamic testing at the Union Twist Drill Company.

Condensed Specifications for the instrument that will aid in the design and quality control of any type of rotating or reciprocating device.

Intense, White Light — more than 70 times brighter than previous model.

Extremely Short Duration Flash (1 to 3 μsec) — "freezes" motion; shows details heretofore impossible to see.

Measures Speed Directly — with better than ±1% accuracy to 25,000 rpm; useful to at least 250,000 rpm.

Long-Throw Beam — reaches into heart of complex machinery; made possible by new flash tube developed exclusively for this instrument.

Unique Carrying Case — provides protection and doubles as an adjustable stand. Patent No. 2,966,257

Type 1531-A STROBOTAC® Electronic Tachometer and Motion Analyzer . . . $260.

Write for Complete Information

GENERAL RADIO COMPANY

WEST CONCORD, MASSACHUSETTS

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Circle No. 60 on Readers' Service Card

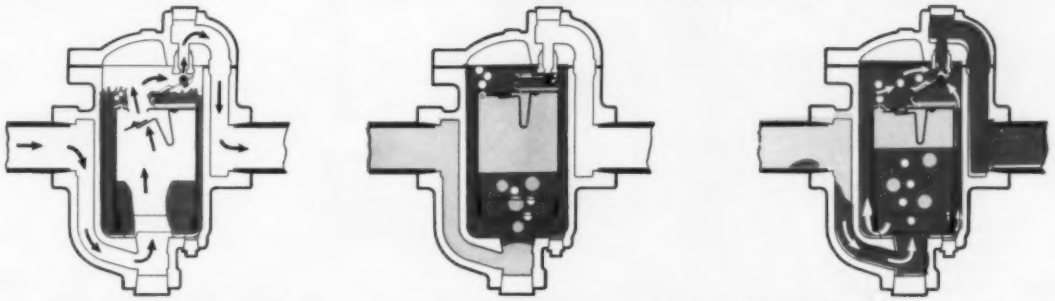
Just How Does an OF&T* Trap Differ from an Inverted Bucket Trap?

*Open Float and Thermostatic

A frank statement about the design and purpose of a trap with a confusing name

First, let's take a look at the way an OF&T trap works--

CONDENSATE | STEAM | STEAM BUBBLES | AIR BUBBLES | AIR FLOW | CONDENSATE FLOW



1. Steam pressure pushes air through large thermostatic vent and out through the trap discharge valve at full differential pressure between the supply and return line. Condensate formed by incoming steam also goes right through trap.

2. Steam reaches trap. Thermostatic vent closes. When ⅓rds full of steam bucket rises to close trap valve. Residual air and CO_2 now escape through standard vent **at steam temperature.**

3. Condensate arrives displacing steam causing bucket to lose buoyancy and pull on valve lever. Weight of bucket, multiplied by the leverage, opens the valve against steam pressure. Condensate is discharged until steam restores bucket buoyancy.

An Armstrong OF&T trap *is* an inverted bucket trap, but is does have some important differences:

1. An OF&T trap is equipped with a thermostatic vent for removal of large volumes of air encountered on start up.
2. Discharge orifices are sized to remove large volumes of condensate at low pressures (0-15 or 0-30 psi).
3. Pipe connections are oversized to meet piping requirements of low pressure intermittent service.

We felt these differences were sufficient to justify a new name—if only to simplify discussion, specifying and ordering. However, some of our friends and competitors have said that the OF&T trap was only an inverted bucket trap with a thermostatic vent. We take this as a compliment because our whole idea was to make the many proven advantages of Armstrong Inverted Bucket Traps conveniently available for low pressure service where large amounts of air are encountered on start-up. (We also figured we could sell more traps this way which we have.)

Inverted Bucket Advantages

CONTINUOUS VENTING— In addition to the big air venting capacity on start-up provided by the OF&T design, the basic inverted bucket principle provides continuous air venting after the trap is hot. Air and carbon dioxide escape through the fixed vent in the bucket and are discharged when the trap valve opens. This continuous venting of air and CO_2 is accomplished simply by the difference between the density of the steam-air-CO_2 mixture in the bucket and the density of the condensate surrounding the bucket. No cooling lag is required that would permit CO_2 to go into solution to form corrosive carbonic acid.

DIRT HANDLING — The turbulent flow of condensate under the edge of the inverted bucket and the fast sinking—fast floating action of the bucket keep dirt in suspension so that it is discharged along with the liquid. There is no likelihood of dirt lodging in the valve seat and no possibility of sludge accumulation on a bellows.

CORROSION RESISTANCE — The entire mechanism of Armstrong OF&T traps is economically fabricated from stainless steel—more corrosion resistant than parts usually used in other types of traps for low pressure intermittent service.

DEPENDABILITY — The ability of the OF&T trap to keep itself clean and the use of stainless steel parts contribute to dependability and long life. Unlike some other types of traps for this kind of service, OF&T traps "fail open"—a remote possibility but an important safety feature.

What Should You Do About It?

From our admittedly biased viewpoint we think that Armstrong OF&T traps should be used exclusively on low pressure intermittent service. This may not be so obvious from your viewpoint.

Nevertheless, we think it will be well worth your while to investigate OF&T traps for trapping requirements on low pressure unit heaters, preheat and reheat coils, converters, hot water generators, etc. The following printed material available on request will help you:

Catalog K — The inverted bucket story in detail.

Bulletin 252—Trapping Unit Heaters (including recommendations by make and model).

Bulletin 254—Draining and venting preheat and reheat coils.

Ask your Armstrong Representative or write: **Armstrong Machine Works, 8943 Maple Street, Three Rivers, Michigan.**

P.S. Just to humor us and for safer communication, we would appreciate it if you would refer to our inverted bucket traps with thermic vents and big pipe connections as Open Float and Thermostatic Traps.

ARMSTRONG STEAM TRAPS

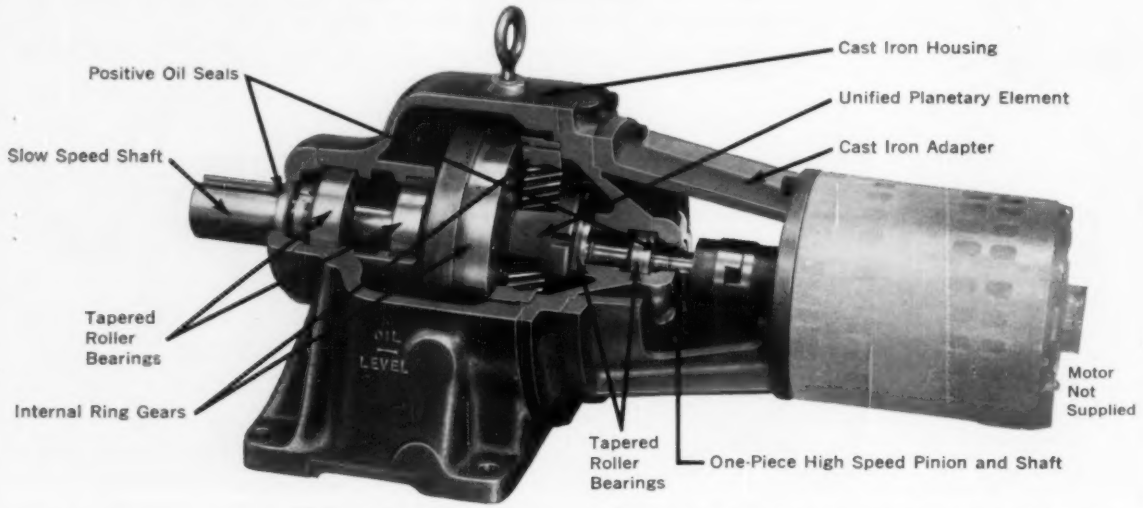
112-ST

Circle No. 12 on Readers' Service Card

Engineering Data

WINSMITH SPEED REDUCERS

HORIZONTAL MOTORIZED DIFFERENTIAL SPEED REDUCERS



CAST IRON HOUSING—designed for high heat radiation. One-piece construction, close-grained gray iron for maximum strength and rigidity.

UNIFIED PLANETARY ELEMENT—integral primary and secondary planetary gears, mounted in a ductile iron cage—for even wear, equalized load, smooth operation. Hardened and ground, alloy steel gears carry entire power transmission load.

CAST IRON ADAPTER—permits use of any standard "C" flange motor. Flexible coupling (optional) connects motor to input shaft which can be driven in either direction.

INTERNAL RING GEARS—primary and secondary. Cut from alloy steel, heat treated for wear resistance.

ONE-PIECE HIGH SPEED PINION AND SHAFT—machined from alloy steel with teeth cut integral with the shaft. Hardened and accurately ground to close limits.

SLOW SPEED SHAFT—heat treated, precisely ground alloy steel. Low speed gear web of ductile iron.

TAPERED ROLLER BEARINGS—opposed pairs support the radial load, take thrust, ensure permanent alignment of both input and output shafts.

POSITIVE OIL SEALS—chevron type, keep oil in, dirt out. Oil and heat resistant, non-abrasive, low coefficient of friction.

AVAILABLE in any ratio from 1.1:1 to 50,000:1 without increasing the number of parts. Each model has a range of reduction ratios. Overall dimensions of individual models do not change regardless of ratio.

- *7 Models*
- *.12 to 81.51 H.P.*
- *Ratios 1.1:1 to 50,000:1*
- *Max. Output Torque 50 to 113.000 in. lbs.*

Series HM Horizontal Motorized Speed Reducers are a part of the Winsmith Planetary Differential Reducer line. They feature cut-tooth helical gears of 15° helix angle for smooth, positive power transmission—greater load carrying capacity—larger reduction ratios in smaller, more compact units—minimum wear and long service life. Winsmith Horizontal Motorized Differential Reducers are easy and convenient to install, require no bedplate, deliver more horsepower per pound of weight and cubic foot of space, and permit easier integration with the driven machine.

Write today for complete information or call your nearest Winsmith Representative listed in the Yellow Pages. He is a technically trained expert who is always ready to help you with any speed reducer problem. For both standard and special power transmission applications, you'll find it pays to standardize on Winsmith.

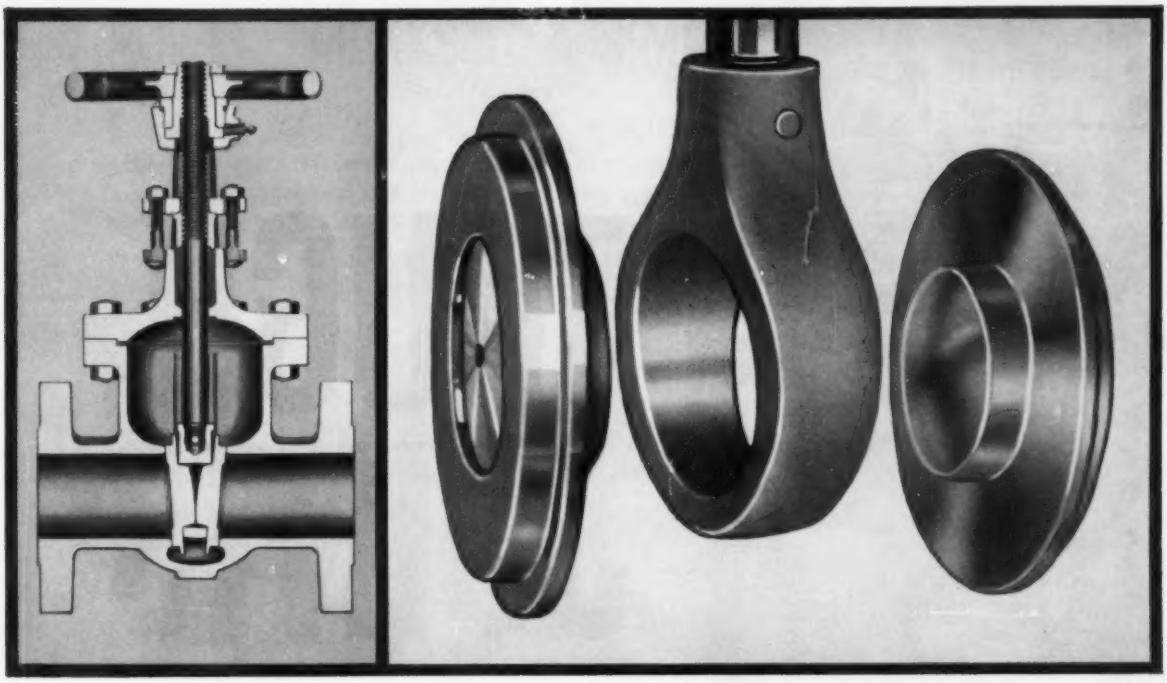
WINSMITH, INC.

203 Eaton Street, Springville, (Erie County), New York

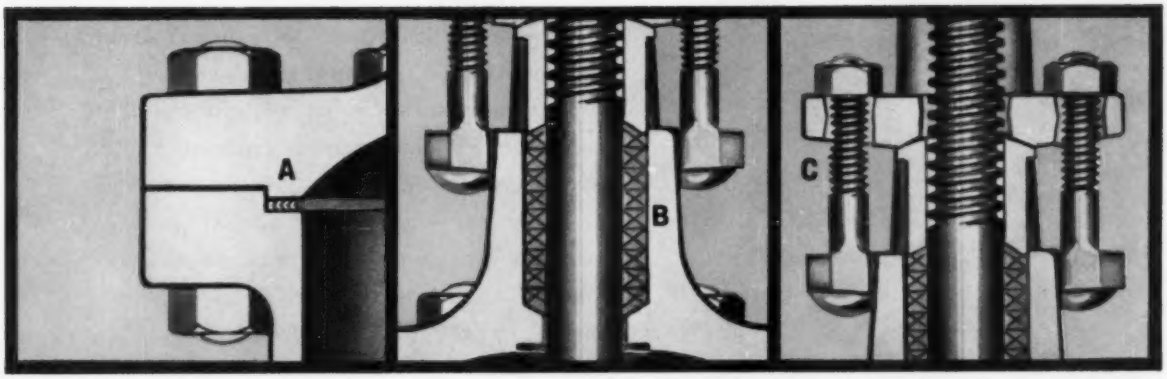
MEMBER OF AGMA

• • • Winsmith Speed Reducers are made by American craftsmen to meet American design and production standards.

Circle No. 138 on Readers' Service Card



New 300 & 600-Pounders extend Crane line of stainless steel gate valves. Feature unique, free rotating, split-wedge disc.



The unique Crane split-wedge disc design features two identical disc halves, fitted back to back in a carrier that is fastened to the valve stem. The moment the lower portions of the disc halves contact the seats, the carrier exerts uniform pressure on the beveled sides of both disc trunnions, forcing the disc halves outward against the seats. This results in a perfect seal and long trouble-free valve life. Free rotation of disc halves prevents wear and galling, keeps seat faces clean.

Other quality features include **(A) Recessed, spiral wound bonnet gasket** which permits face to face abutment of body and bonnet flange. Provides predetermined gasket loading. **(B) Extra deep stuffing box** for tightness and long life. **(C) Thru stud-bolts** for easy upper valve servicing.

There's a wide choice of Crane Stainless Steel Gate Valves in 18-8 SMo or CRANELOY 20 in 150, 300 and 600 Pound Classes with screwed or flanged ends, temperatures up to 800 F. (300 & 600 Pound) . . . up to 500 F. (150 Pound).

For complete details contact your Crane Distributor. Or write to Crane Co., Dept. O, Industrial Products Group, 4100 South Kedzie Ave., Chicago 32, Illinois. In Canada: Crane Ltd., 1170 Beaver Hall Square, Montreal.

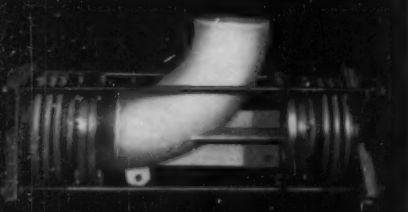
Circle No. 40 on Readers' Service Card

AT THE
HEART
OF HOME AND
INDUSTRY

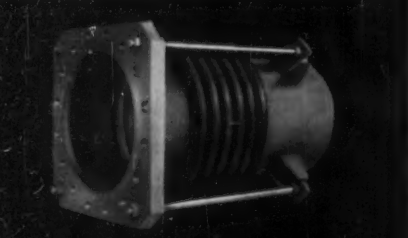
CRANE

VALVES AND PIPING
ELECTRONIC CONTROLS
PLUMBING
HEATING • AIR CONDITIONING

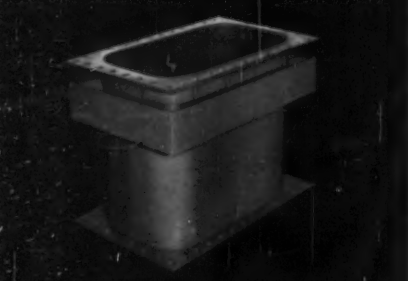
This pair of universal expansion joints is installed in the vapor piping of a gaseous diffusion plant. The lines carry Freon 114 at pressures up to 500 psig and temperatures ranging from −20°F to 300°F. Joints accommodate 3" lateral movement under these extremely harsh service conditions.



A 12" pressure balanced elbow assembly specially engineered by Badger for use in LOX storage and transfer facilities at an Air Force Missile Base. The unit is designed to operate at temperatures from −297°F to 250°F — a thermal shock range of nearly 550°! Operating pressures vary from 0 to 150 psig. Joint movement: 0.8" axial, 0.15" lateral.



One of eight specially engineered Badger Expansion Joints at a power plant for a gas recovery unit in Texas. Installation is on a cooling water piping of the surface condensers where service conditions require operation at 55 psig at a temperature of 107°F. The joints are designed to absorb ½" lateral movement in combination with ¼" axial movement.



This 24" x 44½" I.D. rectangular expansion joint, connects the turbine and condenser at a steam power plant. Each of the units is designed to operate at a pressure ranging from full vacuum to 1 psig at a temperature of 360°F. The joint handles ⅜" axial compression and a plus or minus ⅛" lateral movement.

TOUGH JOINTS

— BADGER SPECIALTY

Anyone with the necessary manufacturing facilities can fabricate expansion joints. But it takes an *experienced* manufacturer to analyze tough piping problems properly and then provide the correct expansion joints to solve them. Badger, with more than 55 years in the field, has had more experience with a wider variety of special design problems than any other expansion joint manufacturer. Put this store of skill and knowledge to work for you — get the most effective and economical solution to your expansion joint problem. Call or write for complete information about Badger S-R Expansion Joints and our "on-the-spot" engineering service.

BADGER
MANUFACTURING COMPANY

230 BENT STREET, CAMBRIDGE 41 MASSACHUSETTS

Representatives in Principal Cities

Circle No. 17 on Readers' Service Card

POWELL MAKES IT A SIMPLE MATTER

To find the right valve for power plant installation, just call Powell. It's that simple, since Powell can supply just about any type of valve you may need to control water, oil, gas, air, steam or corrosive fluids.

What's more, you don't have to wonder about Powell performance. It's built-in through sound engineering, development, materials and workmanship . . . and proved day in, day out.

So, remember, finding the right valve can be a simple matter when you specify Powell. For further information, call your nearby Powell Valve Distributor (there's one in every major city), or write us direct.

2500-pound Steel Pressure Seal Gate Valve—Fig. 125023. Mounted with electric motor operator for remote control.

1500-pound Steel Pressure Seal Horizontal Lift Check Valve—Fig. 11365. Special design provides maximum flow when wide open.

900-pound Steel Pressure Seal Angle Valve—Fig. 13033. Powell Pressure Seal Valves are available for pressures from 600 pounds through 2500 pounds and higher.

See our Catalog in Sweet's

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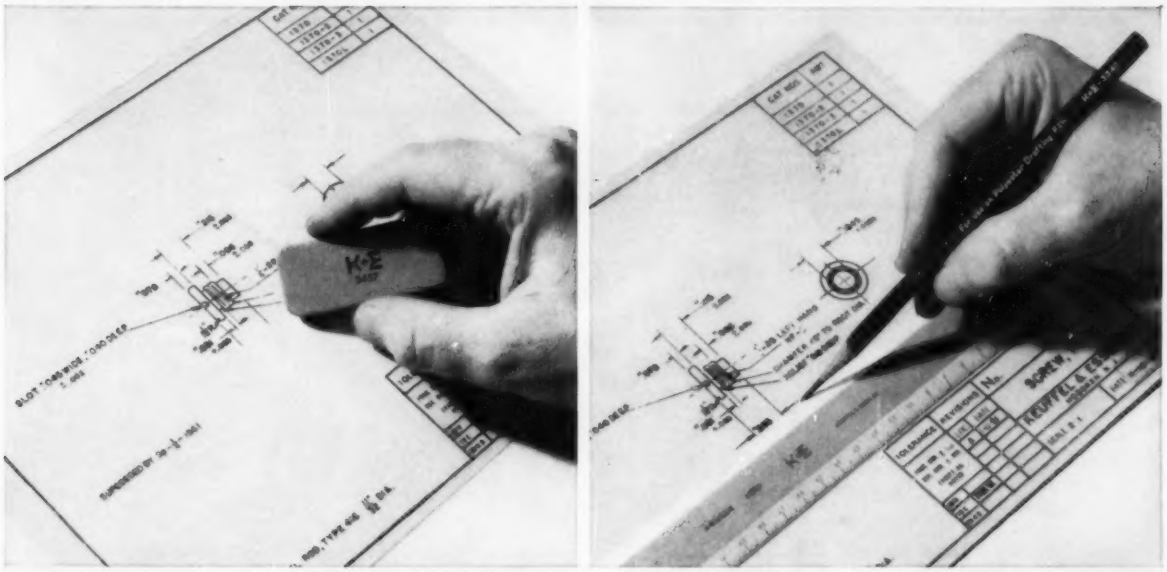

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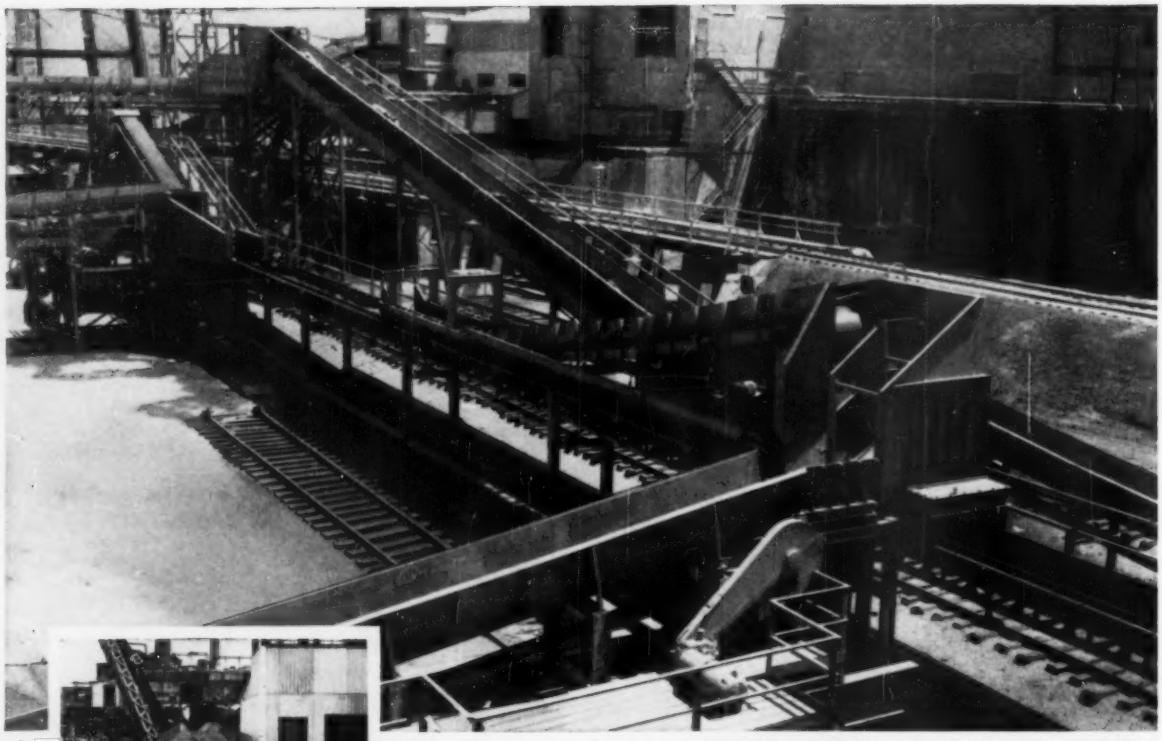
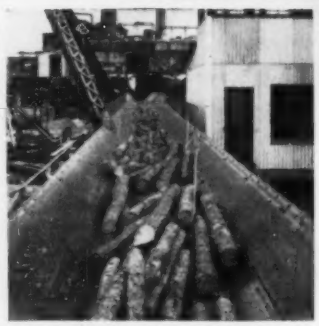
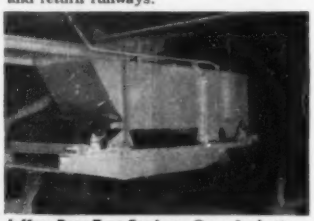


Jeffrey Conveying Machinery was first installed at this pulp and paper mill over ten years ago . . . and selected again for use in these recent additions to the company's facilities.



Jeffrey Type PW Combination Chain with S-212 spur attachment is used on this pulpwood conveyor. Service demands heavy chains with extra large surfaces to withstand wearing action of sand and grit in troughs and return runways.



Jeffrey Drag Type Feeders—One of a battery of feeders under chip storage bin. Chips pass through upper strand of flights to bottom plate. Lower strand carries them to discharge point over belt conveyor.

Jeffrey 36" x 36" Type B Wood Hog—Reduces bark and broken pulpwood sticks from barking drums.

Jeffrey equipment again selected when this mill was extended

The expanded facilities of this pulp and paper mill include Jeffrey conveyors, chain, and machinery . . . and a lot of credit for their re-specification goes to other Jeffrey equipment installed in the original mill over ten years ago.

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JEFFREY

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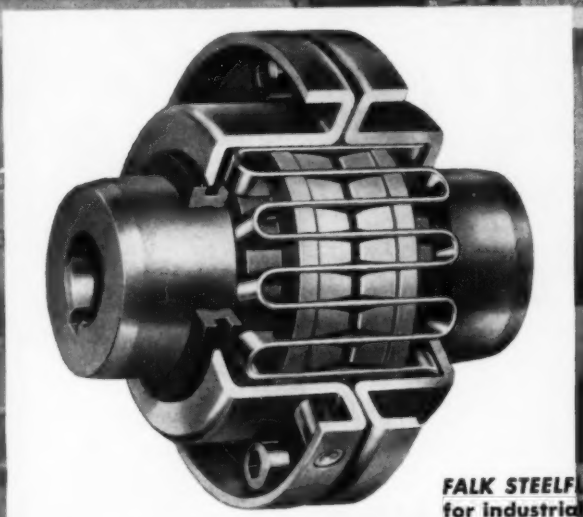

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On a blooming mill at the Copperweld Steel Company plant in Warren, Ohio, installation of a large Falk Steelflex coupling between motor and pinion stand eliminated troublesome noise and vibration which threatened to damage mill machinery. Transmitting 5,000 hp at 50/100 rpm, this is not the largest Falk coupling... others are designed to transmit up to 130,000 hp at 100 rpm.

This installation and others like it prove the Falk concept of shaft coupling design—namely, a modern shaft coupling must contribute to the successful performance of the machinery system.

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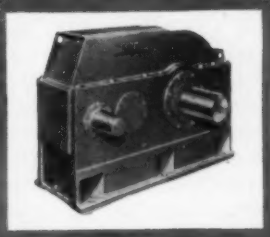

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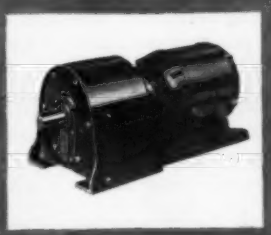

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Heat Transfer. Engineering analysis in the fields of heat transfer and fluid mechanics. Responsibilities will include systems engineering studies on the thermal, hydraulic and thermodynamic performance of advanced reactor systems.

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Reactor Analysis. Complete nuclear thermal and structural analysis including criticality, flux and power distributions and fuel cycle analysis.

Reactor Operations Evaluation. To establish detailed operating procedures, direct operations, and evaluate the performance characteristics of compact, lightweight nuclear systems for space applications.

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Preliminary Design. Several years experience in reactor systems analysis and design with interest and ability in preliminary analysis and design of advanced nuclear systems for space and terrestrial uses.

Please contact: Mr. A. M. Newton,
Personnel Office, Atomics International,
8900 DeSoto Avenue, Canoga Park, Calif.

All qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin.

ATOMICS INTERNATIONAL
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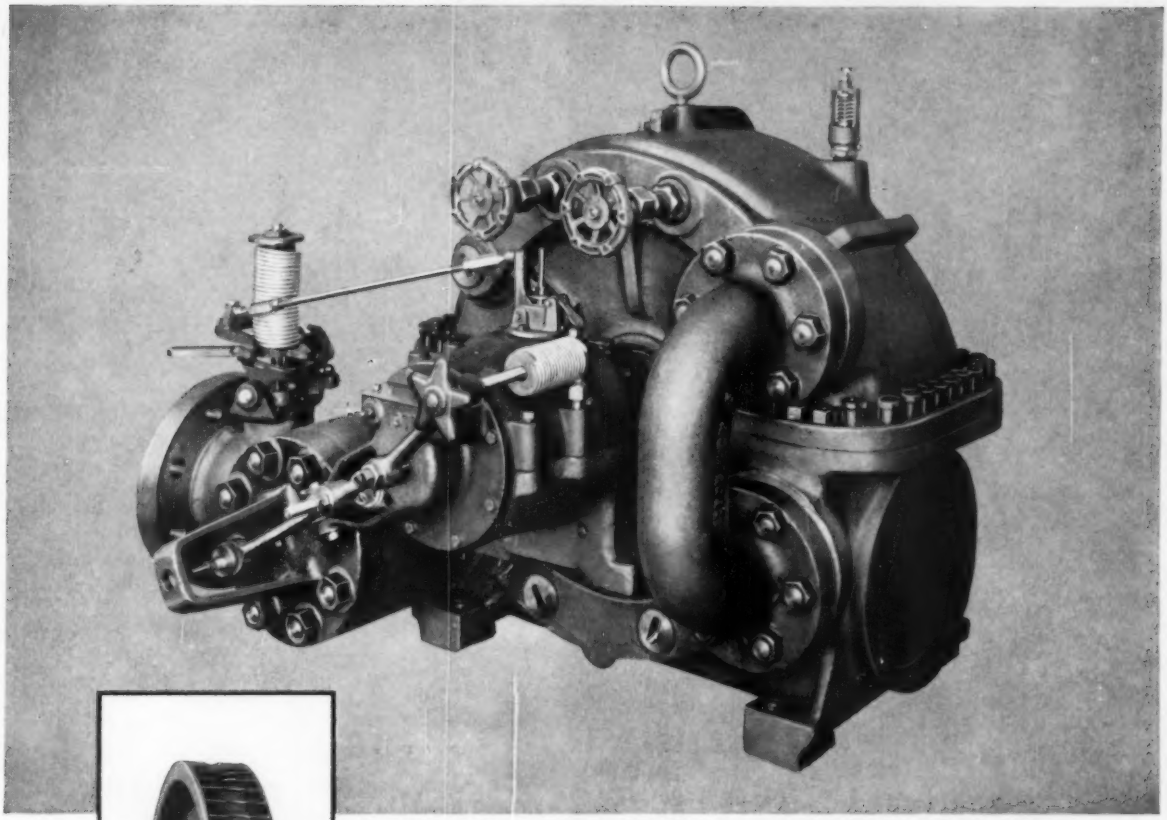

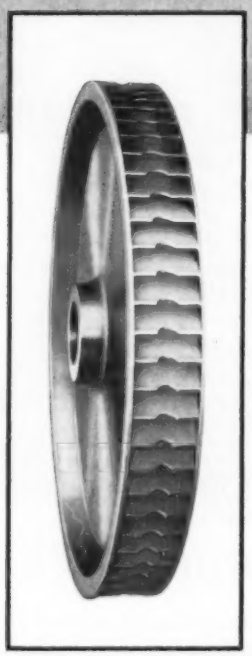

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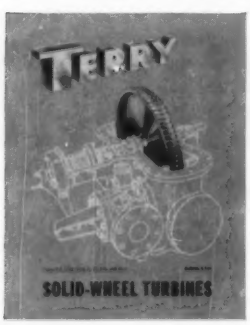

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Discusses in detail the design and performance of the Terry solid-wheel turbine. Ask for bulletin S-159.

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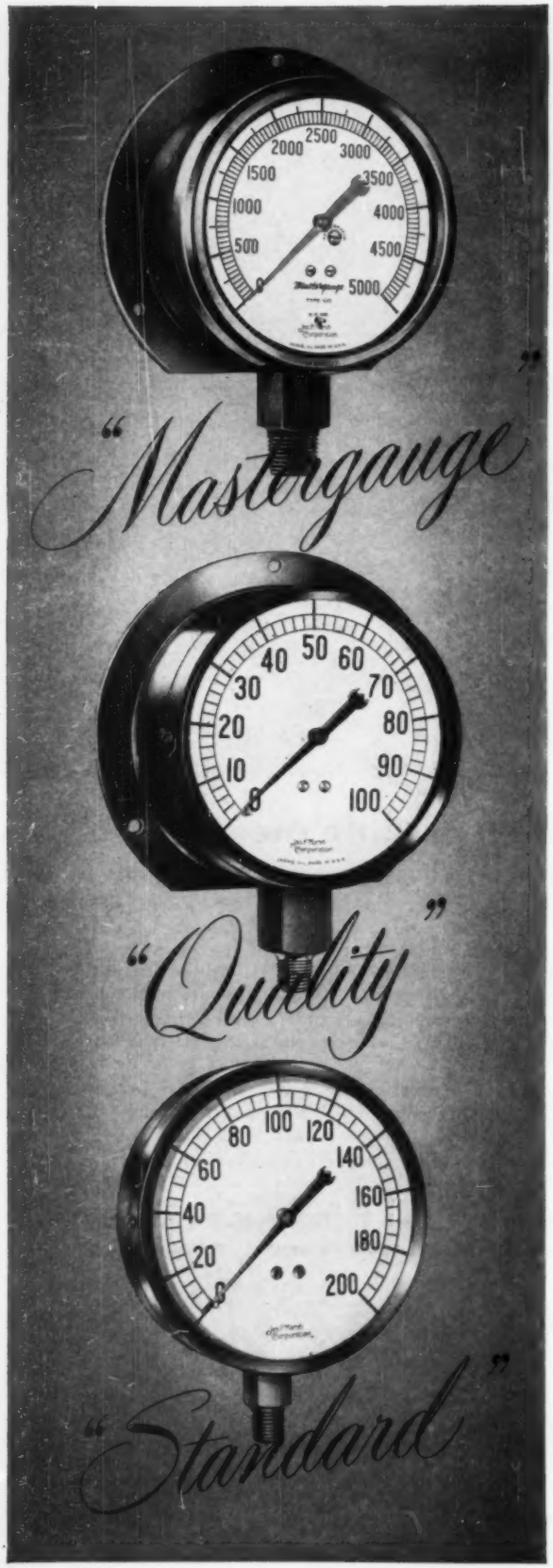

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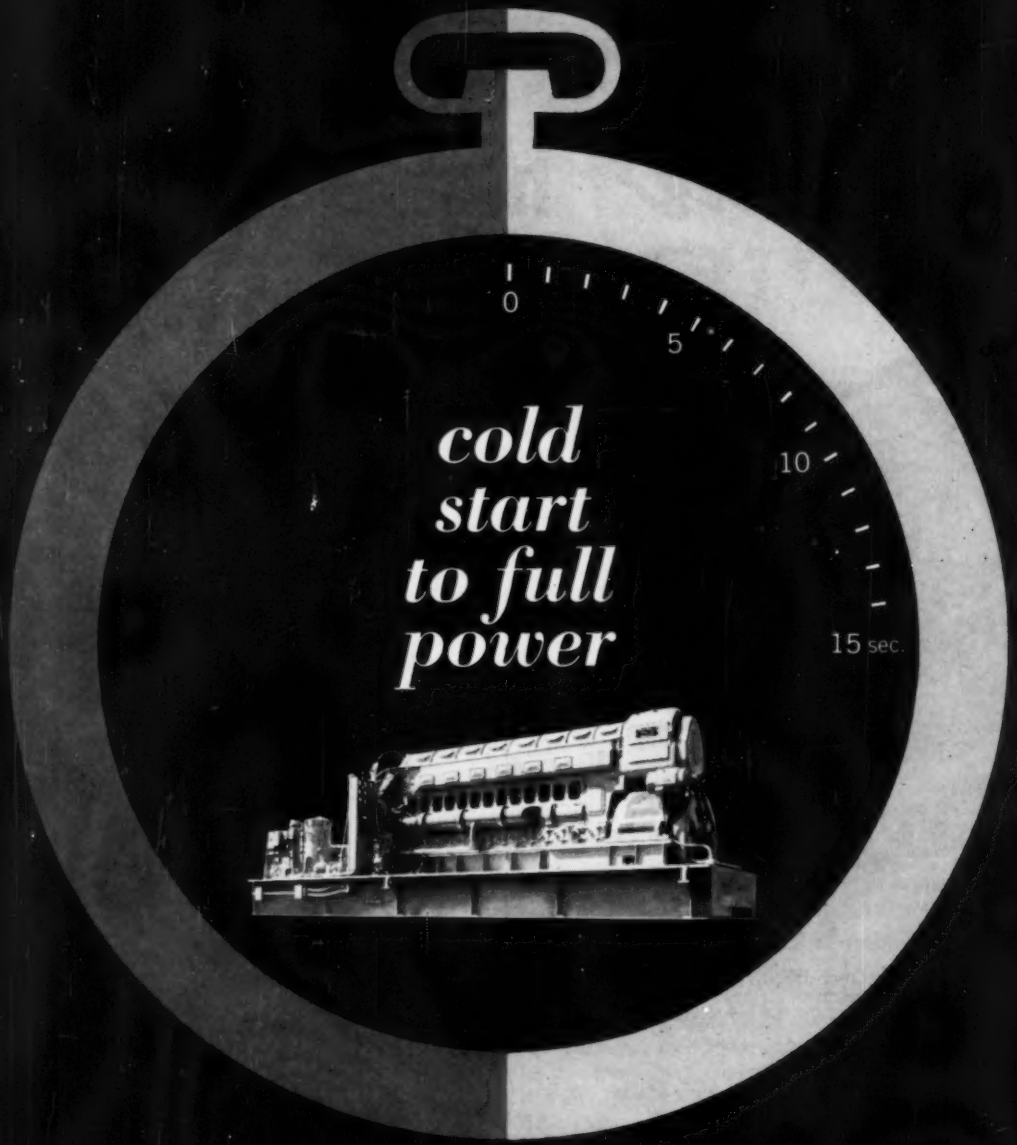

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This unit requires no spinning reserve . . . uses no power until it starts, then produces up to 2500 kw per unit. Can be linked in multiple units.

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Opposed-piston design minimizes vibration, produces fine balance . . . smooth power and instant response that result in 15 second full-power operation. Available with 4, 5, 6, 8, 10 or 12 cylinders, ranging from 450 to 2500 kw per unit, with automatic or manual controls. **For full details or custom specifications, write today to: S. K. Howard; Director of Marketing; Fairbanks, Morse & Co.; Beloit Division; Beloit, Wisconsin.**

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MECHANICAL ENGINEERING

VOLUME 83 • NUMBER 12 • DECEMBER, 1961

They're Talking About . . .

THE ECONOMY. Leading U. S. economists expect 1962 will be a record-breaking year in most respects, according to a poll conducted by F. W. Dodge Corporation. The consensus of 316 economists surveyed is that all major indicators of the economy will advance in 1962, many of them setting new records. Gross National Product (in current dollars) is expected to rise steadily throughout the forecast period but with some slight slackening in the rate of growth as the business recovery matures. The median estimate of GNP at seasonally adjusted annual rates ran from $525 billion in the third quarter of 1961, to $552 billion in the second quarter of 1962, to $565 billion in the last quarter next year. Industrial production is expected to show a steady rise next year, the economists said. The median forecast calls for a seasonally adjusted Federal Reserve Board index of 116 this month, picking up to 120 by June, 1962, and reaching 122 in December, 1962. Most of the economists also expect a rise in plant and equipment expenditures in 1962.

RESEARCH. Research spending in the United States will amount to almost $16 billion in 1962. This prediction was made by Battelle Institute economist George W. James at the annual meeting of the National Association of Business Economists. Dr. James estimated that the government would spend about $10 billion for research next year, reflecting stepped-up space and defense programs; industry about $5.5 billion, up $600 million from the 1961 estimate; and universities and foundations about $350 million. In 1950 research spending totaled only $3 billion.

"FUMIFUGIUM: Or the Inconvenience of the Aer and Smoake of London Dissipated." This is the title of a small book written by John Evelyn and presented to England's King Charles in 1661. *Progress Report* for September, 1961, states that while it is true that *Fumifugium* is an old—perhaps the oldest—publication in the air-pollution field, age alone does not make it important. Change a few archaic spellings and grammatical constructions and Mr. Evelyn's 1661 London Report is strikingly similar to a report that could be written in 1961 on any one of hundreds of cities throughout America. Sources, medical and economic effects, in fact most of the elements of a modern discourse are present in this work. But most important is a proposal to control air pollution through city planning. Needless to say, this is a vital means of air-pollution control today.

PROFESSIONAL SOCIETIES. At the annual meeting of Engineers' Council for Professional Development, Arthur B. Bronwell, Mem. ASME, President of Worcester Polytechnic Institute, said that "our professional societies deal only with the present; they are not concerned with the future. There is nothing in any of our professional societies that even remotely attempts to come to grips with the far reach in man's ideas. Today, if we want philosophical, speculative projections of the future, we read *Fortune* or *Life* magazine, for we most certainly will not find them in our scientific or engineering society meetings or journals." (Ed. Note: We hope President Bronwell is excluding MECHANICAL ENGINEERING. Some recent articles: Productivity in the Future, Ultrahigh Strength Materials of the Future, What May Be Ahead in Power Production, Exploration of Space.)

A MERGER. First steps to consider consolidation of the two largest engineering societies in the U. S.—the American Institute of Electrical Engineers and the Institute of Radio Engineers—have been taken recently. The proposed new organization would be international in scope and involve 150,000 engineers, scientists, educators, and industrialists—undoubtedly making it the largest engineering society in the free world. A feasibility study is under way.

Editor, J. J. JAKLITSCH, JR.

THE TIME IS NOW

Soon, you'll be asked to vote on measures

By D. E. Marlowe,[1]

Secretary, ASME Intersociety Relations Committee

For more than a decade, various attempts have been made to secure a greater degree of unity in the engineering profession. Nearly all engineers recognize that the initial formation of our profession in terms of specialties has hampered our development and weakened our voices. For the past three years, the grass-roots membership of ASME, expressed through successive resolutions of the Regional Delegates Committee, has insisted on more rapid progress toward engineering unity. The ASME Council established the Intersociety Relations Committee and directed it to seek a basis for agreement with other engineering societies.

Starting with the Dallas meeting in June, 1960, your committee has met nearly every other month, either alone or with similar groups in other societies. We have discarded false hopes, vain regrets, and intolerant attitudes as we have come to realize the aspirations and problems of other groups. We rejected the cynical approach—How do you define Unity? . . . Everyone's for it, but who will give up anything for it? . . . Who's against Motherhood? . . . and similar comments. The persistent urging of our membership is too real for us to take such an easy escape. We define the task of Unity as the optimum marshalling and allocation of the resources of our profession in attacking the many crises which confront us. We have achieved our greatest measure of agreement with AIEE and NSPE. With them, we have agreed upon a joint statement of principles which has been submitted to our governing boards for adoption.

VOTE "AYE"

Members vote **"AYE"** on an ASME Constitutional amendment to require Registration as one of the qualifications for full Member Grade in ASME.

ASME members who are also NSPE members vote **"AYE"** on an NSPE constitutional amendment to establish the grade of Engineer Member in NSPE.

Recommended by the ASME Intersociety Relations Committee

Basic Principles

Briefly, these principles are as follows:

1 The basic principle and the division of areas of responsibility (technical, educational, and professional) encompassed in the functional concept[2] are sound and should be implemented by engineering societies intent upon improving the organization of the engineering profession.

2 In the implementation of the functional concept, an integrating body is desirable not only as a mechanism for assuring understanding among domains, but as an outward symbol of unity within the profession.

3 The chief responsibility of ASME to its members lies in the technical domain. Although not obliged to relinquish any services now offered members, we should restrict our activities outside the technical area and should participate in the co-ordination of broader matters with other appropriate groups.

4 Complete acceptance of the functional concept by

[1] Dean, School of Engineering and Architecture, Catholic University of America, Washington, D. C.; Vice-President ASME, Region III.

[2] The "functional concept" proposed some realignment of responsibilities as among Engineers Joint Council (EJC), Engineers' Council for Professional Development (ECPD), and the National Society for Professional Engineers (NSPE). See MECHANICAL ENGINEERING, Feb., 1958, pp. 57–59.

an individual engineer necessitates his membership support of both a technical society and a professional society. Each society should urge such dual membership on its members.

We believe that this statement of principles offers a basis for a more orderly organization of the engineering profession. However, the principles are not enough—they must be supported by specific actions.

The implementation of principles 3 and 4 is the purpose of this article. The facts are these: The profession faces crises in education, crises in interdisciplinary technology, and crises in legislative matters. Every engineer is affected by these crises, and bears some responsibility for their resolution. For better understanding, these crises may be further defined. In education, such problems as the opposition of "science" and "design" philosophies, four-year versus five-year curriculums, the proper direction of graduate study in engineering, continued specialization versus the common first degree, and so on, are under debate. In technology, the proliferation of meetings, the doubling of printed papers every ten years, the competition for advertising revenue, the growth of additional societies, and so on, demand attention. In professional work, the increasing amount of legislation affecting engineers, the compulsory unionization of engineers in some areas, the encroachment of architects and planners on traditional engineering activities, and so forth, require constant surveillance.

With such problems as these and many others facing us, the profession cannot afford internal disorganization. No single society is equipped to serve the individual engineer in all of these areas. More importantly, your Intersociety Relations Committee has come to realize than no single society can, even in the future, meet the requirements and serve the interests of the individual engineer in all of these areas. Hence, principle 4.

proposed by ASME's Intersociety Relations Committee. Here's a briefing on steps being taken.

Dual Membership

This point must be understood! We state unequivocally that by custom (which could probably be changed, but slowly) and by law (which in its tax aspects, at least, is unlikely to change), the individual engineer who wishes to be fully represented over the complete gamut of engineering must give his membership support to both a technical society and a professional society.

The obstacles to this concept of dual membership are substantial and center on the matter of Engineering Registration. We are convinced that, ultimately, all professional engineers will have to be registered. There is now, in every state and most foreign countries, a legal status of Registered Professional Engineer. This movement will not wither away—in fact, it appears to be growing by leaps and bounds. It appears that nearly 50 per cent of the qualified engineers are now registered. (Remember that the graduates of the five most recent years, nearly 150,000 strong, are not yet qualified because of the requirement for experience.) However, only ASCE, among the technical societies, requires Registration for its highest grade of membership, and the NSPE, the only professional engineering society (in the sense used here), demands Registration for membership. Hence the objective of dual membership for all qualified engineers seems ridiculous, when nearly half the profession is unregistered. Perhaps we could wait until a larger number of the young men of our profession are registered, but our problems seem too pressing, and the demands of our membership are too insistent to permit this approach.

To resolve this dilemma, your Intersociety Relations Committee has recommended to the Board on Membership and to the Council that

> ASME establish Registration as an additional requirement for full membership to be effective when the Constitutional amendment is approved. All Associate Members will be urged to upgrade their membership before that date, and those who have achieved the grade of Member by that date will retain it henceforth. After the given date, Registration will be an additional requirement for Member Grade.

Simultaneously, NSPE is amending its Constitution to establish a grade of Engineer Member, containing all membership privileges except that of holding national office, which will not require Registration as a qualification, and which will be open to the Members of those societies which have adopted Registration as a qualification for Member grade at some specified date. This Engineer Member grade in NSPE will be available only for a limited time, probably three years. After that, Registration will again be required for membership in NPSE as it is now. However, Engineer Members will retain their membership indefinitely.

Time of Decision

Both of these proposals require constitutional amendments by their respective societies, and both, therefore, depend for their adoption upon the votes of the individual members. As an ASME member, you may have a dual interest. You certainly should vote favorably on the proposal to adopt registration as an additional requirement for ASME membership. If you are also an NPSE member, you should also vote favorably on the proposal to establish the Engineer Member grade in that Society. The interrelation between these proposals is the subject of this essay.

The implementation of this plan depends upon an "aye" vote of the membership of our Society on these proposals. Delay will not lead to better solutions. To your committee, the issue is plain, the matter is urgent. Positive and affirmative action on your part is required. The time is now.

England. At Bedford, England, the 130,000-sq-ft plant of Texas Instruments shows an unusual roof of hyperbolic parabolic topped bays.

THE MODERN FACTORY

Western Europe goes ultramodern. This British consultant finds new methods and layouts

By D. L. Nicolson,[1]

Production-Engineering Ltd., London, England

In Europe, productivity has been rising at a world record rate for several years now, and the creation of the European Common Market is widening outlets and encouraging industrial growth. Over 700 American and 500 British subsidiaries have been formed in it already.

In America, despite threats of recession, the volume of industrial building still continues to grow, and the larger corporations are developing their international activities. New plants must be designed.

Requests often come for project surveys from underdeveloped countries which need help in establishing new plants for the first time, or requests are made by banks or financial houses for capital-expenditure proposals to be reviewed, as an audit of the prospective borrower's business plan. In these cases a wide approach must be made, and studies of markets for the proposed products, potential locations for the proposed plant, or availability of the desired labor need to be included.

General Considerations of Layout

The establishment of branch factories in new locations or overseas may involve differences in the quantity of products to be manufactured. In turn, this may demand a new local policy for investment in tooling and automation, with the attendant problems of providing for staged expansion in the future which will permit economic advantage to be taken of larger batch quantities or flow production.

Obviously, this affects the approach taken to layout and buildings design and, in many cases, design of the new plant should be based on its size after an estimated growth of 10 or more years and then redrawn by stages back to the limited aims of the present. Undoubtedly, the correct approach to any new layout is to attempt to design the ideal in general terms, incorporating the maximum of new techniques and handling devices, and then to amend this plan in the light of present practicable technical, financial, and labor possibilities.

In Britain, sickness costs 75 times more man days lost per year than industrial disputes, and over a quarter of this sickness can be attributed to psychological causes. Nor are these figures believed to be much out of line with other industrial countries. The morale and output of a labor force can be much affected by working conditions, and much work has been carried out recently to measure their true effect. It has been found that drawing office output under the best artificial light is still 11 per cent less than under good northern natural light. Elimination of noise in a test in a weaving shed resulted in 12 per cent more output. In summer, the difference between good and poor ventilation may account for from 3 to 10 per cent more production. But no one has yet measured the psychological effect of poor working conditions and the resulting loss in cooperation, morale, and efficiency.

All these factors naturally affect layout. So do

[1] Managing Director.

Contributed by the Production Engineering Division and presented at the Production Engineering Conference, Toronto, Canada, May 10–12, 1961, of The American Society of Mechanical Engineers. Condensed from Paper No. 61—Prod-16.

France. A new factory in France, in which full use of the partial basement provides for employee facilities under the working area.

-A WORLDWIDE VIEW

to improve plant design and introduce automation. New materials play an increasing role.

communications, and care must be taken that the most important employee, the supervisor, can in fact have a small enough section to enable him to act as a true leader, and get around it.

A Plant to Work in

There has been a recent trend toward making fuller use of basements or partial basements in factory design. They are very suitable for provision of employee facilities, where they are provided more cheaply than in any other location, and by this means congestion on the production floor due to general traffic or shift changes can be reduced.

In a new light-engineering factory in France, the workers' entrance is under the factory, where dressing-rooms and showers are provided and access to the working floor is by staircases in a central block, which runs down the factory, containing washrooms and offices, with all air-conditioning ducts and machinery above them. The difficulty with this type of arrangement, however, arises when heavy machinery has to be installed, as the foundations for this equipment must be at the base of a factory building.

The reverse arrangement may therefore be employed sometimes and the workers' entrance and facilities set above the main production area. In the case of part of a new automobile factory in Italy, elevated walkways above factory roads and marshalling areas are planned for the workers' entry.

From the point of view of layout and building arrangement, materials-handling policy is naturally vital. The effect of over or underprovision of mechanized-handling facilities is significant. Building costs increase continually, and the best utilization of both floor space and cubic capacity must be obtained while at the same time providing adequate gangways, safe trucking, and necessary working access around conveyers, and so on.

Considerations of packing, containerization, and storage of goods also play an important part today. In many cases, both incoming materials and outgoing products are packed to suit the convenience of the user, with a consequent effect on factory stores arrangements.

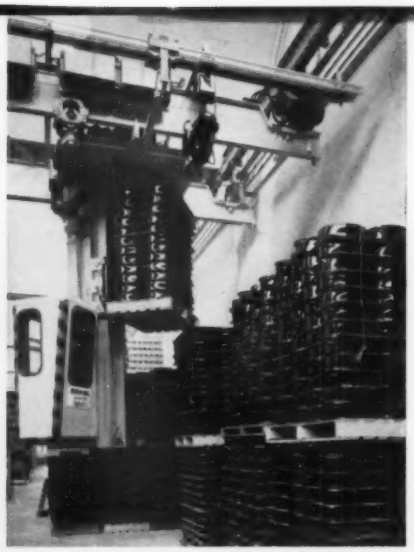
On the whole, single-story plants are seldom found more expensive in the long run than multistory plants, and the advantages of gravity handling which are often ascribed to the latter are counterbalanced by the need for heavier foundations, elevators, and higher initial construction costs.

The "Flatted Factory"

A new type of general development in factory layout in several cities, including Birmingham in England, and Paris in France, is the use of "flatted factories." These multistory buildings include numbers of individual floor areas which are leased to small manufacturing companies by the city authorities. In the case of Birmingham, the flats are only available for firms displaced by the big city-redevelopment scheme, and in one 8-story building 46 units of 1500 to 3000 sq ft are available, each with gas, water, and electricity separately metered. Communal washing facilities, elevators, lighting, maintenance, and cleaning are provided and 7 to 21-year leases are offered to the tenants.

Moving into a new factory can also present serious problems, and the stages at which production is trans-

England. An example of wide-span, welded roof construction in England—by Conder Engineering Co., Ltd.



Germany. A German-made overhead stacker crane handling loaded pallets—an example of how handling equipment may affect layout of a building.

ferred have to be carefully worked out on the time schedule. In one recent case where a major automobile manufacturer in England decided to transfer the production lines for some vehicles to a new factory some 200 miles distant from the parent factory, it was decided as a matter of principle to establish the toolroom and training center on site 6 months ahead of the first transfer of production. This plan enabled recruitment and training to proceed ahead of construction of the main plant, and, in particular, local labor and supervisors were taught the company's approach to production organization in time to make a real contribution.

The program time cycles for plant selection, preparation of handling and layout details, buildings design, materials ordering and delivery, and construction on site are analogous to a factory plan for manufacturing a given product. The same problems of communications, late deliveries, or faulty materials may arise, and an equally thorough approach to solving them needs to be taken if construction time is to be met. The master control program is set up during the initial project survey, with progress check points and careful briefing of all concerned including contractors. Subsequently, variances and their effect on progress can be recorded and acted on as sufficient advance warning is given automatically.

Building Design and Materials

Only when all aspects of process plant, handling, automation, and interior layout are being reviewed can the merits of different shapes, types, sizes, strengths, and costs of buildings be fully compared. Industrial architecture becomes more and more functional and an integral part of plant layout and process planning.

An example is in brewing industry bottling plants. There is an optimum building size for warehousing when considering the best use of cubic volume in storage. Extensive handling plant of the overhead-suspension, stacker-crane type has to be built into the design to get high stacking, and the product must be packed in suitable containers. A large clear span building is desirable with a roof which will support a carefully distributed suspension-crane handling system, and the various working floors should be a series of shelves or mezzanines at one end of the building, which are accessible by the main handling equipment in the warehouse. This gives a versatile layout, easy operating, and all processes can be seen.

Heating and air-conditioning requirements today often affect the whole concept of an industrial building, where employees are at work, and special conditions of humidity, temperature, or air cleanliness have to be provided for processes. In a modern electronic or precision engineering plant cooled, heated, and filtered air will be supplied to 90 per cent of the covered area, and 85 per cent of the air may be filtered electrostatically. Air-handling ducts and service piping will be installed above the building trusses, where platforms and walkways will form an integral part of the building frame.

Electrostatic air filtration, employed in conjunction with the air-conditioning system, and in particular where smoke or fumes are likely, is expensive to install, but in the right applications it will pay for itself in less than two years. Apart from helping labor relations by providing healthier working conditions, it reduces cleaning time and redecoration costs, and is indeed necessary for many advanced manufacturing techniques.

Interesting developments in electric floor heating have also taken place in Britain recently, where cheap electricity is available 15 hr per day during the "off-peak" period, and concrete with its high thermal capacity can be used to "store heat" from a night-time warming-up period. Cable heating elements are installed in floors or walls of staircases, with metal screens set in to protect and reinforce the plaster in the latter case. Ramps to underground garages can be kept clear of ice in this way.

Structural Elements

Great progress has been made in recent years by engineers and architects in Europe in developing non-

England. Coming up; one roof. At Texas Instruments, Bedford, England, a roof slab which has been cast at ground level is lifted into position.

Denmark. "Siporex" lightweight, precast, concrete roof slabs, in a Danish textile plant. Cellular structure gives it a quarter the weight of normal concrete, with high thermal insulation.

traditional, economic, and pleasing methods of building construction for industrial plants. One example of this is the wide use of a German engineer's design of roof structure, based on a series of curved welded steel arches with conoid concrete shells spanning between them, the whole of which is subsequently post-stressed. This north-light roof can be employed in spans of up to 210 ft clear, and is capable of carrying loads of up to 15 tons at any point. It costs no more than $3 to $4 per sq ft of floor area covered for the frame, roof, and north light glazing, but excluding floor, sides, and foundations.

In one-story industrial buildings frame elements are likely to continue to be predominantly simple steel-bolted spans of beams or trusses, and low-carbon steels being developed will provide greater flexibility in stress range and safety factor. Where welding is used for whole or part units, the flush surfaces of joints are simple to maintain, and the plastic method of design permits maximum economy in use of material. With portal frames, a clear roof space and good appearance are achieved in this way which often reduces building height and construction and heating costs, with greater frame spacing and lower cost of foundations. Another factor permitting greater frame spacing is the use of cold-rolled purlins of high-tensile strength between the portal frames.

Structural steel is still used in more than 90 per cent of industrial building, but its biggest competitor in the future will be reinforced concrete—either poured in place, precast, prestressed, or post-tensioned. Concrete poured in place is frequently desirable for multistory buildings, particularly where heavy floor loadings are to be provided for. Precast concrete permits rapid assembly and reduces construction time, and the reuse of forms for large numbers of internal units leads to a great reduction in carpentry and form work. Prestressed concrete permits longer spans and shallower members for roofs and floors, and is also especially effective for resisting cracks caused by corrosive fumes. Furthermore, concrete facading gives more scope to the architect's imagination in creating a pleasing appearance.

Aluminum, too, must be considered as a material which will be made greater use of in the future. Sandwich walls have been used successfully in many applications with an insulating medium such as $^3/_4$-in. fiberglass between asbestos or aluminum, and although the latter is two or three times more expensive, its life is two or three times longer. Recent tests indicate a maintenance-free life of 40 to 60 years according to conditions, and this is of particular interest in tropical areas where long life is required in sun or sea.

It is practicable to erect an economical sandwich wall of this type which has 2.3 times the insulation of a 9-in. solid masonry wall or 1.8 times that of an 11-in. cavity wall. The best design is with troughed section aluminum externally and flat section with pressed "roll" stiffening internally. Corrugated siding and prefabricated panels are attractive, with hidden fasteners, more visible flat area, and fast rate of construction. Many new joining methods are appearing, such as welding, adhesives, sealants, and blind rivets. Aluminum roofing has a long life with a clean and bright appearance and good heat-reflecting properties.

The Role of Plastics

Plastics have good general resistance to corrosion, evidenced by their use in industrial piping, good electrical insulation, low thermal conductivity, and a high strength-to-weight ratio. In Europe it is common for plastic films to be used as temporary enclosures for winter construction. They are also used between layers of concrete as damp-proofing or over-site waterproofing. Internally, they can be used as a refinishing medium with a life span of 15–20 years, also translucent sandwich-panel cores and jointless tile coating for wall surfaces are being adopted freely. False ceilings of translucent plastic with built-in lighting arrangements are also in evidence now within some factories, having the advantage of reducing the space necessary to heat.

Engineering Malpractice

THE term malpractice simply means the negligence of a professional individual. The widest usage of the term has been in connection with the medical profession, but it is just as applicable to any professional conduct. The lay individual thinks of malpractice as a criminal action or a quasicriminal act, where the accused will be subject to a jail sentence and/or censure by his profession. In reality, a lawsuit brought by an individual or plaintiff who alleges malpractice is a suit based on a theory of negligence where the plaintiff seeks to recover a sum of money for the injuries he sustained. The injury need not be physical but may be property damage or a combination of both.

Malpractice results from a definite physical act and is not a state of mind. Society has imposed upon man an external hypothetical standard of conduct, and when he falls below that standard, negligence results. This fictitious standard is in reality what the public thinks an average reasonable engineer would have done in similar circumstances.

The court set forth a workable parameter or test for gaging an engineer's conduct in the case of *Cowles vs. City of Minneapolis*. In that case the plaintiff was employed as an engineer and the court said, "That in performing the work which he undertook it was his duty to exercise such care, skill and diligence as men engaged in that profession ordinarily exercise under like circumstances."

From the Cowles' case and the general concept of negligence it becomes evident that whether an engineer has committed malpractice is a question of fact and hence normally a jury question. Since this is a question in human relations, the guideposts that determine negligence must be rather general and imprecise. Such things as custom, technique, testing, inspection, contractual obligations, and expediency of the situation are some of the factors that must be considered in determining a professional individual's conduct.

[1] Attorney-at-Law, Licensed Professional Engineer.

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Expert Testimony

The courts generally agree that the plaintiff has the burden of proving to the jury that the defendant engineer has failed to comply with the standard of his profession. The court, since it is not technically trained, has to place great reliance on the use of experts to help determine the facts. Experts can be frustrating because of the reluctance of an individual to testify against his professional colleague, and the general unwillingness of people to become involved in a lawsuit. The author feels that perhaps the strongest reasons for this reluctance is that engineering is more art than science and hence the large gray areas preclude definitive condemning statements. The courts are cognizant of this, and because of the so-called wall of silence of professional individuals, the qualifications for experts in some jurisdictions have been liberalized, particularly as pertains to the medical profession. It is conceivable, therefore, that an engineer may be allowed to testify as an expert in a field outside of his particular specialty. This reticent attitude of professional individuals when called upon for co-operation lowers the administration of justice.

If it is shown by expert testimony that there are several valid approaches to a particular problem, and they are all recognized methods, it is doubtful that the courts will infer negligence.

A Battle of Experts

There are instances where the burden of proving lack of negligence is cast upon the defendant engineer. This legal doctrine is given the name *res ipsa loquitur* (the thing speaks for itself). It is literally the plaintiff proving his case by circumstantial evidence. The inference has to be based on evidence and human knowledge. If the plaintiff can show that he did not contribute to the accident by his negligence; that the agency or instrumentality which caused the accident was under the exclusive control of the defendant; and that negligence was necessary before the accident could happen, the plaintiff has made out a case of *res ipsa loquitur*. The defendant, in these cases, must then prove that his design, supervision, testing, or opinion had no causative relation to the accident. It can readily be seen that such a doctrine

By Irwin L. Tunis,[1] Assoc. Mem. ASME, New Orleans, La.

The engineering profession is a life of service, the obligations legally binding. Just where do your obligations stop, those of others begin? Will a court one day point the finger at you?

where applicable often causes a lawsuit to become a battle of experts.

In some jurisdictions, instead of the normal inference of negligence due to circumstantial evidence, the courts have directed the defendant to give an explanation for the causative reasons of the accident, otherwise the plaintiff may have his damages. This broadening effect of *res ipsa loquitur* is in the minority but may be applicable to professional liability, since the present tendency is to place the risk of loss on those who can bear it, with less emphasis being placed on fault.

Contractual Relations

The law seemed to be well settled that an individual could only be held liable if there existed a contractual relationship between himself and the other party. The engineer would, under this privity of contract concept, not be liable to third persons. Utilizing this theory, an Indiana court found an architect free of liability to a third person. His design failed to provide for a railing along a particular ledge, and a child fell from the said ledge. The plans were approved by a school trustee and hence the architect could insulate himself from liability because there existed no contractual obligation between the architect and the injured child.

The professional individual under this theory had a very minimal exposure to liability. The privity of contract doctrine was rather unrealistic as it eliminated an engineer's or manufacturer's negligence from the general public, the very individuals for whom his service or product was designed.

In the landmark case of *McPherson vs. Buick Motor Company*, Judge Cardozo wrote an opinion which sounded the death knell of a contractual relationship requirement. The McPherson case dealt with the liability of an automobile manufacturer to the consumer. In holding for the plaintiff, the court spoke of foreseeability of usage of the vehicle, and rejected privity of contract between manufacturer and distributor as a bar to the plaintiff's recovery.

A recent Federal Court decision reiterates this doctrine. In this case the defendant designed gas pressure vessels for the storage of gas in liquid form. Thirteen months after completion of a vessel it blew up. The court allowed recovery even though the defendant did not work in the liquefaction and storage plant and the gas utility had accepted delivery.

Although the previous case, dealing with the architect, has never been overuled, it is doubtful in the light of the present jurisprudence that it would be followed today and protect the architect or engineer for faulty plans and specifications in relation to third parties.

Foreseeability Doctrine

As a result of 45 years of jurisprudence, the foreseeability doctrine is almost universally accepted and has been extended to include any third person that may be in the vicinity of the thing's use and would be endangered if the item was defective.

In another New York case the court extended the doctrine to include the defective design of a building. Hence the present jurisprudence probably will allow recovery not only for a movable item but also for such things as buildings and other immovable structures.

The foregoing case dealt with a six-year-old building. On the surface it would appear that a statute of limitations would bar recovery even if the defendant was negligent. Unfortunately, this type of statute usually commences to run from the date of the accident. The courts have allowed recovery 18 years after the completion of a building for injuries sustained by a third party. In a recent case the plaintiff could recover against a crane manufacturer 15 years after the machine had been put into service. One cannot assess a definite time limit on negligence. It is best therefore to assume that a professional individual can be held liable during his entire career.

Responsibility of the Engineer

The Louisiana Supreme Court in their recent decision on *Day vs. National U. S. Radiator Corp et al.* held that an architect was not responsible for a subcontractor's method of doing work. In this case the contractor's workman was killed by a boiler which exploded immediately after installation while being tested.

The contract between the architects and the owner

Engineering Malpractice

contained the following provisions: "Adequate supervision of the execution of the work to reasonably insure strict conformity with the working drawings, specifications and other contract documents" . . . "frequent visits to the work site." The court reversed two lower courts in deciding that this meant simply the need for frequent inspection trips to the site to insure the owner that all work was in accordance with plans and specifications, but there was no duty to inspect the contractor's methods unless the contract made specific provision for same. Therefore, there was no duty to the deceased.

The Louisiana court would not absolve the architect from liability because of the contractor's negligence. It is basic in the law that one whose negligence combines with that of another to cause injury cannot plead the negligence of the other and hence escape liability. The architects only escaped in this instance because of contract and the court's refusal to make the professional an insurer of the work of a subcontractor.

Generally Accepted Usage

General usage of a product by the public and therefore a generally accepted design approach may also not permit the designer and/or the manufacturer to escape liability. In one case the plaintiff sued the manufacturer alleging brake failure as the proximate cause of his injuries. It was shown that the brakes failed in an air-operated system after a petcock sheared off allowing the fluid to escape. The defendant, General Motors, contended that this was the first accident of its type, and that millions of miles of actual use had been accorded to the design. The court said that this was not conclusive on whether operations were conducted with care.

Hidden Defects

The technically trained individual or corporation is under a duty to warn of latent or hidden defects. The engineer is not precluded from designing inherently dangerous machinery, such as grinding wheels, lathes, milling machines, and the like. There is no obligation by anyone to make the article safe or the design safe if the danger is apparent to all. An example of this theory is the case where the plaintiff lost his hands in an onion topping machine. Although the machine did not have a safety guard, the court dismissed the complaint because the dangerousness was apparent to all.

The Legislature may impose negligence via statute. The Wisconsin legislature has adopted a statute that corn shredders are to be equipped with safety or automatic feeding devices. The various building codes and electrical codes are other examples where the failure to comply may be negligence *per se*.

Component Parts

Some jurisdictions may hold a manufacturer liable for the failure even though he did not make the faulty component. The theory is that anyone who puts forth a product as being of his manufacture is liable for the defect of the component parts.

The defendant who purchases a component from a third party cannot use the defense that his vendor was required to inspect and test the part. Usually, the defendant system manufacturer has the duty to inspect and test another's equipment if he is going to use same as a component.

Liability and Damages

The two elements that must be present in any malpractice suit are liability and damages. If a person suffers no injury even though the defendant may have been negligent, the recovery can only be token at best. The damages can either be personal injuries or property. The New York Court recently denied an airline recovery against an engine manufacturer even though the engines were defective, since no accident had occurred. The court went on to say that the plaintiff could perhaps recover on a theory of warranty.

In warranty, everyone becomes a guarantor of his work. In recent years the concept of warranty has grown and expanded, since, as mentioned previously, there is a growing tendency to place the burden of payment for accidents due to defective items on those who can bear it.

Breach of Warranty

Negligence in many cases is very difficult to prove, while breach of warranty may be considered as strict liability. Under one theory of warranty, it is not considered as part of a contractual obligation but rather a responsibility to any member of the consumer population that may be injured. This is a warranty of merchantability, a guarantee of fitness for the purpose for which the goods are made, rather than for the buyer's particular usage.

High Professional Standards

The engineering profession will probably never purge itself completely of negligence, but several things can be done. The most significant advance is for the profession to raise its own standards. Make engineers more cognizant of the canons of ethics and their duties and obligations to the general public because of their special skills; continuing technical education on the part of the individual engineer. The constant acquisition of new skills and knowledge will do more to make the engineer safe than almost anything else.

Another suggestion is to constantly improve industry standards. A particular industry has to be the most severe watchdog of itself. The constant requirements for new and better products by an industry coupled with the ever-increasing requirement for decreased lead time may tend to lower the quality control standards. Also, the greater stress and load requirements on such items as pressure vessels, pipe, heavy equipment, and structural members may lower standards by making present specifications obsolete.

Product testing and inspection techniques have to be constantly improved so that the dynamic system for which the product is slated can be more nearly duplicated.

It is only by every engineer being constantly aware of his obligations to his fellow man and giving his best by using the total accumulation of science and technology can his exposure to negligence be minimized.

There are such legal devices as corporate status, contractual relations with the consumer, and insurance that limit one's legal exposure; however, these pale into insignificance when compared to the simple concept of the "integrity of the engineer."

By M. L. Levene,[1] Assoc. Mem. ASME, Radio Corporation of America, Camden, N. J.

AIR LUBRICATION

A DEVELOPMENT TOOL

Gas bearings, with their great convenience and accuracy, can make possible the economical tryout of a new device, leading to an informed decision on further development

In addition to the uses of air lubrication in the end products, there has been an equally valuable use for this lubrication and positioning technique as a tool in engineering development and experimentation.

The self-centering properties of the externally pressurized bearing have proved very valuable as has the uniformity of the rotating friction torque. Devices which make use of air as a lubricant profit from its relatively low viscosity which varies little with temperature. The resulting constant friction torque generally is sought in many forms of tape-drive mechanisms as well as in gyros and in memory drums.

Because the surfaces moving relative to each other are separated by the lubricating gas, the provision of special surface hardness on the bearing materials becomes a safety feature instead of an operational necessity.

The film of air which exists between moving and nonmoving elements provides electrical insulation.

Suitable gases are easy to find. For externally pressurized systems, filtered and compressed ambient air is a convenient lubricating gas. While it is generally advisable to provide for oil and water removal, a compressor with the necessary filtering and regulation equipment can be provided to most industrial locations and laboratories. Gases such as helium, nitrogen, and so on, can be obtained in pressurized bottles or tanks. For self-lubricating systems, closed chambers containing ambient environments of the same dry gases can be set up. Thus the lubricant is available, is relatively inexpensive, and is easy to utilize.

The literature in this field has become so plentiful that The Franklin Institute has been able to prepare and publish an impressive bibliography [1][2] devoted entirely to treatises on gas (principally air) lubrication. Several works have been published which provide sufficient design information to guide interested engineers in the construction of adequate gas bearings for numerous applications [2–7].

Advanced Development Work

The problem facing engineers employed in advanced development work is generally the evaluation of technique feasibility rather than the prototype design of individual components. The development engineer in industry is also frequently challenged by either time schedules which seem too short or by funding which seems too limited.

The authorization of future design effort and financial expenditure may depend upon the success or failure of the early experiments. It is therefore necessary that the phenomena and techniques under consideration be examined under conditions which offer the greatest opportunities for experimental success. The establishment of a high level of confidence for the particular scheme under test is most important. Attempts at simultaneous final design and early experiment create commercial bonanzas if successful, but, if unsuccessful, might impose limitations which could obscure the advantages and success of the technique being evaluated and thereby inhibit progress. It would be unfortunate, indeed, if a novel approach to the solution of an engineering problem were to be discarded because deficiencies in auxiliary apparatus prevented an accurate test.

One example which can illustrate the effective use of air lubrication as an auxiliary development tool is found in the development and test program undertaken by the author to evaluate the use of self-acting air bearing flota-

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[2] Numbers in brackets designate References at end of paper.

AIR LUBRICATION
A DEVELOPMENT TOOL

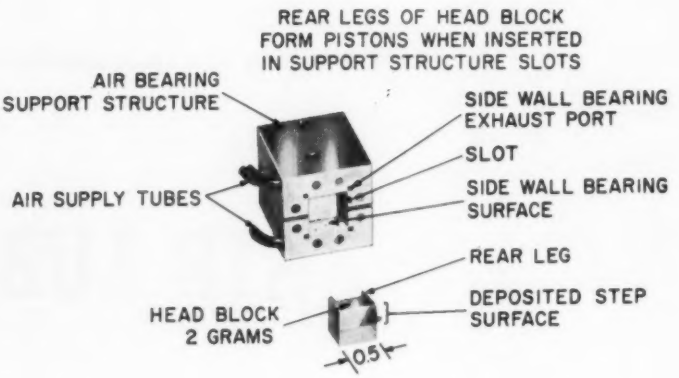

Fig. 1 The support structure, and the head block designed to float within 100 microin. of a magnetic memory disk. The four rectangular holes are exhaust ports. The eight circular spots are the plugged ends of holes drilled to produce air-distribution channels. The block was held in position by externally pressurized air bearings on all four walls, and pressed toward the disk by compressed air. Clearance from the disk was established by a self-acting step air bearing.

tion in the support of magnetic recording transducers, or "heads," from the surface of a magnetic memory disk.[3] In these devices the preservation of a constant head-to-disk clearance is essential to the reproduction of undistorted information. Fixed-position heads were generally unsatisfactory since they could not compensate for variations in the surface of the magnetic disk.

A data recording-and-processing system was under consideration which seemed feasible if a disk recorder could be supplied in which a constant clearance of 100 microin., or less, could be maintained between individual recording-head packages and the spinning memory disk. The delivered models of this recording system would have to be operated in an area in which compressed air was not available and in which space could not be allocated for the installation of a compressor. Other system considerations demanded a disk speed which would produce a disk-surface velocity of 5000 ips across the head.

Question: Will It Work?

The best solution appeared to be a design which would ultimately incorporate standard precision ball bearings for the support of the disk, and self-acting air lubrication to support the heads away from the disk surface. At that time, however, there was no experimental evidence that a recording head could be floated 100 microin from a recording disk whose surface was moving at 5000 ips, and this feature alone could decide the success or failure of the proposed system. As is often the case, time was so limited that the first test program would have to be sufficiently successful to prove the feasibility of the design approach.

It was decided to disregard the lack of pressurized air in any final model and to apply the advantages of externally pressurized air wherever they would serve a useful auxiliary function. If confidence in self-acting air flotation at 100 microin could be established, then subsequent design effort could replace the externally pressurized air bearings with other devices more suitable.

Hardware for a Test

An aluminum disk of 8-in. diam was attached to a shaft $1^1/_2$ in. in diam and 4 in. long. The shaft was supported against radial and thrust loads by externally pressurized air bearings, which were designed and constructed on the basis of published information [2, 3] and past experience. The surface finish of the disk was approximately 6 microin.

The magnetic transducer head was represented by an aluminum block weighing 2 grams, which presented to the disk a face 0.5 in square (Fig. 1).

The step profile[4] proposed by Rayleigh [8] was chosen as the self-acting bearing geometry most likely to succeed. The step was designed using the relationships provided by Archibald [4, 5]. The rear half of the face was covered with a 50-microin coating of evaporation-deposited silicon monoxide, forming an 0.5-in-wide, 0.25-in-long, 50-microin-high, step. The surface finish of the step, as deposited, was measured to be 3 microin. The deposited step appears in Fig. 1 as the darker, reflective half of the block face.

The block was constrained by externally pressurized air bearings on its four sides so that only motion perpendicular to the disk was possible. This accurate linear guidance, necessary for the successful operation of the Rayleigh step bearing, was obtainable by use of the side-wall air bearings. Each of the four side-wall bearings was provided with three orifices, approximately 0.013 in. in diam, and arranged so that imaginary lines joining their centers would form a triangle. The bearing clearance at each wall was 0.0005 in., and exhaust paths to atmospheric pressure were provided at all boundaries of the walls.

The dynamic system then consisted of a light mass (the head block) suspended in nearly frictionless supports between a constant force (the air piston) and a stiff spring (the air compressed in the clearance between the disk and the stepped surface of the block). The block was free to follow the surface variations very well because the air spring was stiff and because the constant-force piston always acted to preserve the compression of the air spring to the established clearance value. A disengageable auxiliary mechanical spring was used to retract the head from the disk upon removal of the piston air and also served to substitute for the hydrodynamic forces during static calibration of the proximity-measuring equipment.

[3] This program was part of a larger effort performed at the Radio Corporation of America under contract to the U. S. Air Force.

[4] One element of the self-acting step bearing is composed of a pair of parallel surfaces displaced to form a shallow step. The lubricating film thickness, which is gradually reduced in the more familiar tapered-land or flat pivoted pad geometrics, is instead reduced abruptly at the step.

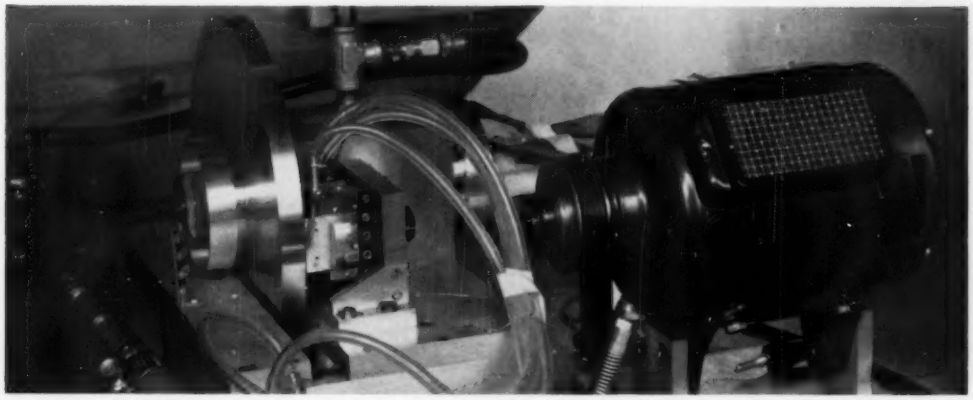

Fig. 2 The test apparatus—disk, floated head, and disk-drive assembly—which proved that a recording head could be floated 100 microin. from a surface moving 5000 ips. With this fact established, expenditures could be authorized to develop a commercial prototype which did not use air bearings.

Measuring the Gap

With the disk floating on air and electrically grounded, and with the head block similarly floating and not grounded, it was possible to use the variation of electrical capacitance to measure the distance between disk and block surfaces accurately during dynamic testing. A capacitance-sensitive proximity meter was calibrated, with the disk stationary and with the piston pressure tending to push the head block against the disk, by inserting Mylar shims (dielectric constant 3.16) of 250, 500, 1000, and 2000-microin. thicknesses between the disk and the head block. The equivalent air gap was then calculated and a calibration curve was plotted. The air-bearing support for the head block had been aligned so that the block face paralleled the disk face as nearly as possible.

During the first attempt at flotation, the disk was first brought to full speed, about 15,500 rpm, following which the head block was slowly caused to approach the disk by increasing the piston air pressure. The approach was being observed through a microscope when suddenly the flotation became unstable and the head block began to reciprocate. The head was immediately retracted and the procedure was tried again, and again the instability appeared.

With flotation of recording heads by means of externally pressurized air in the head-to-disk clearance, two displacements were possible for each piston force until the Bernoulli suction region had been completely crossed and the positive pressure region of very small clearance was reached. Feeling that the instability being experienced might be of the same sort and might be avoided by reaching small clearances as soon as possible, the next approach of the head block was made at a much faster closing speed. This time the head block floated smoothly, and with proper piston air pressure, reached the desired 100 microin., or less, clearance value.

An interesting series of articles [9] and [10] later appeared in which the superiority of the Rayleigh step design over a pivoted flat pad was shown. The pivoted flat slider was reported to be unstable in the smaller clearance range.

The unstable clearance was avoided in subsequent trials by initially placing the head block rather close to the disk (200 microin) and simultaneously increasing the disk speed and the piston air pressure until full operational conditions were reached. After attaining an apparent 80 microin. clearance, the pressure behind the head was reduced and readings were made of head-to-disk distance versus presssure behind head. The calibration was repeated and the test was rerun with identical results. Fig. 2 shows the test set-up.

Mission Accomplished

The test had accomplished its objective. Confidence was established that recording heads could actually be floated 100 microin. from a surface moving 5000 ips. Later design supplanted the disk's shaft air bearings with ball bearings, and due to other considerations, the self-acting flotation itself was changed to a metallic spring-supported, flat-pivoted-pad geometry. These changes were the result of considerable design effort and financial expenditure in the evolution of an operable prototype.

This further development would never have proceeded if the feasibility test had been unsuccessful. The success of the test program owes much to the use of the various air-lubrication devices applied, as described in the foregoing, as temporary tools in the development cycle of a new device and its system.

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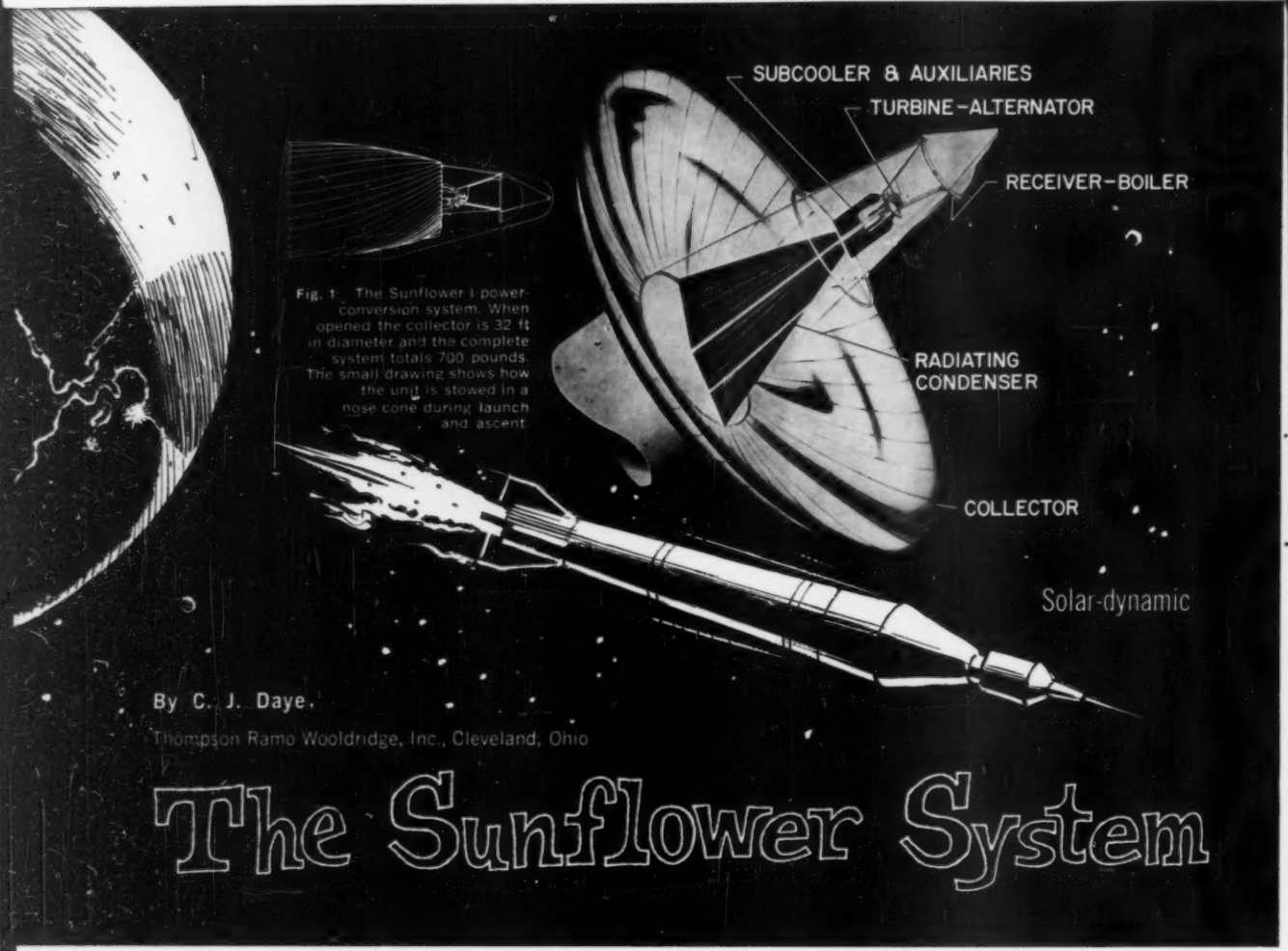

Fig. 1 The Sunflower I power-conversion system. When opened the collector is 32 ft in diameter and the complete system totals 700 pounds. The small drawing shows how the unit is stowed in a nose cone during launch and ascent

The Sunflower System

By C. J. Daye,
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SUNFLOWER I is a Rankine-cycle, dynamic power-conversion system using a solar heat source. It is being developed by Thompson Ramo Wooldridge for the NASA. This is a hardware program, based on Rankine-cycle, turbine-alternator package designs which have been under test for two years. Prototypes have been operated, under load, continuously for longer than 2500 hr at temperatures in excess of 1200 F.

The Sunflower system [1][2] offers growth possibilities. It could result in an entire family of solor-space power systems, capable of providing power from 3 to 30 kw. The system, Fig. 1, consists of a collector, a cavity-type receiver-boiler at the prime focus, a turbine-alternator, a subcooler and auxiliaries, and a directly radiating condenser.

Table 1 summarizes the pertinent specifications and characteristics of the present system. The turbine-alternator package is a modified version of the SNAP II package currently being developed by Thompson Ramo Wooldridge under subcontract to Atomic International, for the Atomic Energy Commission [2]. The SNAP II system employs a nuclear heat source; for the Sunflower application, where total weight is very sensitive to efficiency, the turbine has been modified to the extent of adding a third stage and eliminating the liquid-sodium pump. The solar collector consists of an assembly of rigid segments of epoxy-bonded aluminum honeycomb forming an annular section of a paraboloidal reflector.

A 10-ft scale collector has been built and tested for deployment, optical performance, and vibration characteristics. The hinged-petal concept appears satisfactory for the specified application, and performance estimates for the prototype collector have been directly extrapolated from this model. Collector dimensions were selected by an efficiency optimization method, giving due consideration to orientation sensitivity. The condenser is essentially a plane-surface, finned-tube array. The specific arrangement shown in Fig. 1 was dictated by orbital start requirements and other specifications peculiar to Sunflower I.

The Sunflower I characteristics, as presented in Table 1, are not particularly remarkable when compared with many past and current estimates of what space power-conversion systems ought to weigh. Moreover, an apparently disproportionate amount of the total system weight is contributed by the receiver-boiler unit. These weights result from two basic specifications for the Sunflower I development:

1 The system must operate in an earth orbit which may vary continuously from a 300-nautical-mile altitude (90-min period, 35 min in the shadow) to a 20,000-

[1] Senior Research Engineer, Research and Engineering Requirements, Tapco Group.

[2] Numbers in brackets designate References at end of paper.

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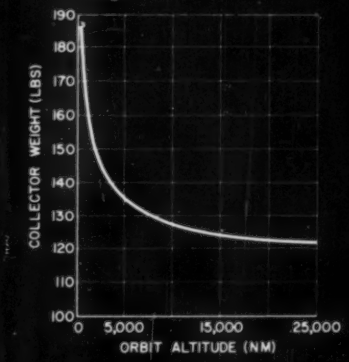

Fig. 2 There is a severe weight penalty for near-earth orbits. Present specifications are for a 90-min orbit, 55 min in the sunlight.

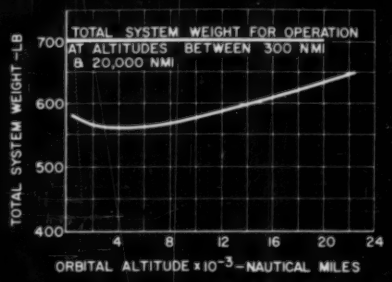

Fig. 3 The effect of adapting to specific orbits. At each point on the curve, it is assumed that operation will be at constant altitude.

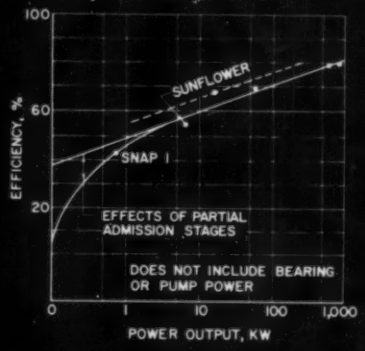

Fig. 4 Efficiency of axial-flow vapor turbines, illustrating that turbine efficiency rises with power level

engine systems find their first outstanding success in providing electric power for space vehicles.

Here is a development program for the effective use of solar energy during orbit.

-Solar Power for Space

nautical-mile altitude (24-hr period, 72 min in the shadow).

2 The system must be based on current state of the art as much as possible, with very little of the total program directed toward new development work.

Growth Possibilities

In considering the growth possibilities of the basic Sunflower concept, the logical starting place is the present system itself. Lighter weight power-conversion systems can result from a choice, or combination, of two development paths:

1 Reduction of system weight by design modifications for specific applications.

2 Reduction of system weight through component improvements, at the same level; or increasing system performance at constant weight by the same method.

Designing for specific applications will result in the reduction of total weight, since the mission requirements affect the two most massive components in the system—the collector and the boiler-energy storage unit. The collector must intercept sufficient solar power to both operate the boiler during the "sun" portion of the orbit and to supply energy to the reservoir for consumption during the "shade" portion. Thus maximum collector size occurs at the lowest altitude orbit, where the fraction of time spent in the sunlight is the smallest.

TABLE 1 Specifications and Characteristics of the Sunflower I Solar-Dynamic Engine Power-Conversion System

Specifications		
Power output	3 kw	
Voltage	110 volts, line to neutral, two phase	
Frequency	2000 cps ± 1 per cent	
Mission requirement	Rated useful power continuously for durations up to one year. Circular earth orbits 300 to 20,000 nautical miles. Shade time 35 min up to 72 min, total orbital period 90 min up to 24 hr.	
Power package	Hermetically sealed Hg vapor turbine-alternator-pump unit.	
Boiling temperature	1050 psia	
Condensing temperature	600 F	
Condensing pressure	6 psia	
Heat storage	Heat of fusion of lithium hydride	
Collector	Outer diameter	32.3 ft
	Inner diameter	9.6 ft
	Focal length	17 ft
	Aperture angle	53 deg
	Cavity aperture	1.2 ft
	Concentration ratio	600
Weight summary	Solar collector 186 lb	
	Boiler & heat storage	260 lb
	Turbine-alternator	30 lb
	Radiator-condenser	62 lb
	Mercury inventory	15 lb
	Speed control	15 lb
	Startup auxiliaries	65 lb
	Structure & miscellaneous	67 lb
		700 lb or 233 lb/kw

The Sunflower System

TABLE 2 Sunflower I Turbine-Alternator Package

Turbine:	3 stage-axial flow impulse type	
	Aero-adiabatic efficiency—66%	
	Internal losses (windage, heat shock, interstage leakage)	0.841 kw
	Mechanical losses (bearings and pump)	0.712 kw
	Net turbine output	4.225 kw
Alternator:	Brushless, synchronous, radial gap, permanent magnet type output 3.5 kw efficiency — 83 per cent	

[a] These characteristics are very similar to those of the SNAP II turbine-alternator package.

Solar Power for Space

Present Sunflower design specifications are for the 90-min orbit, approximately 55 min in the sunlight. Fig. 2 indicates how the weight of the collector can be reduced for higher-altitude orbits. On the other hand, the amount of storage material required depends (using the heat of fusion as the storage mechanism) on the total time in the shade, at constant power output. Hence the weight of this material (and the required container) increases for higher altitude orbits. For example, at the lowest altitude orbit considered for the Sunflower I system (300 nautical miles), 66 lb of LiH are required, while at the stationary orbit altitude (20,000 nautical miles), approximately 150 lb are required. Combining these effects, assuming operation at only one altitude, Sunflower I total system weights over the range from 300 miles to 20,000 miles are as shown in Fig. 3.

With no other modifications, the weight of the Sunflower I system, if designed specifically for an earth-orbit application of 4000 nautical miles altitude, would be reduced from 700 lb to 560 lb, or some 20 per cent (the specific weight becomes 186 lb/kw). For a 55-min-sun and 30-min-shade orbit, the total system weight of the Sunflower I design is less than 600 lb.

For any orbit other than those near the plane of the ecliptic, there is the possibility of essentially continuous operation entirely in the sunlight. Indeed, it has been shown that there exists a particular group of orbits which remain permanently in the sunlight, including all precessional and other perturbing effects. If an application exists for such an orbit, or for near earth missions which can be arranged to be entirely in the sunlight, the energy-storage requirement can be eliminated[b] with a further reduction in system weight.

The specific weights, where specific orbital applications are considered, compare well with various estimates made for solar power systems over wide power ranges [3, 4].

System Development

The Heat-Source Subsystem. Consider, first, the possible fabrication improvements in the solar collector itself. The weight of this component in the Sunflower I design is based on the 10-ft scale collector constructed at Thompson Ramo Wooldridge. This collector was constructed of stock thicknesses and honeycomb density material commercially available. The weight per unit frontal area of the material as fabricated for the present design is approximately 0.25 psf. Structural trial panels have been produced at TRW having a specific weight of 0.20 psf. If sufficient development effort were expended, it is modestly felt that a reasonable ultimate collector specific weight goal of 0.17 psf of frontal area could be achieved.

Improved optical performance of the collector-receiver system over the next four years is expected. In fact, the performance of our deployable scale solar collector as measured to date has already been considerably better than was expected on the basis of preliminary studies. Normal reflectivities of 0.92 have been attained, whereas earlier work was based on values near 0.80. The geometrical precision of the surfaces has been better than estimations made using the literature concerning more conventional uses for solar power. Initial efforts have been made toward the development of solar collectors of extremely high precision for application to thermionic-diode power-conversion systems. A detailed optical-performance development program is an important part of the current Sunflower I program.

The Turbine-Alternator Package. The Sunflower I system employs the basic SNAP power-conversion-system turbine-alternator package concept—a hermetically sealed, integrated unit with only one moving part. The alternator rotor, three turbine wheels, and boiler feed pump are all mounted on one shaft, supported on two bearings which are lubricated with the Rankine-cycle working fluid, in this case, mercury. The characteristics of the Sunflower I package are listed in Table 2. In considering the performance improvement in the turbine-alternator package, the package losses may be grouped as follows: (*a*) Alternator inefficiencies; (*b*) power absorbed in the bearings and pump; (*c*) turbine internal losses, including windage, heat, shock, and interstage leakage; and (*d*) the aeroadiabatic performance of the turbine wheel-and-nozzle combinations.

Consider, first, the alternator. For power-conversion systems in the 1–5 kw power range, a parasitic load speed control and permanent magnet-type alternator appear to be the most practical. The alternator efficiency can rise from its present 83 to about 89 per cent if the power factor can be raised from 0.8 to 1.0.

Next, the turbine. If cycle conditions are altered to allow maximum turbine efficiency, the aeroadiabatic efficiency of the turbine can be increased to between 70 and 75 per cent. This would be achieved by reducing pressure ratios across the stages, which will also reduce shock losses Using this as a guide, it is estimated that through design, fabrication, and test refinements, without sacrificing cycle efficiency, the turbine aeroadiabatic efficiency could be raised to 71 per cent.

The bearings and mercury feed pump are two components of the turbine-alternator package where some improvement can result in Sunflower-system growth. Journal bearings are used with two thrust bearings to provide for axial loads in either direction. The journal and thrust bearings in the present turbine-alternator package are rather conservatively designed. Moreover, turbulent conditions in the lubricant further raise the power dissipated in the bearings. It appears that further development of the bearings coupled with improved fabrication and balancing techniques will allow reductions in the size of the bearings plus improved lubricant flow conditions, resulting in a significant reduction in the power consumed.

[b] A small amount of lithium hydride may be retained for orbital start-up purposes.

Efficiency Rises With Power Level

An important advantage in developing Rankine-cycle dynamic engine components for space-power systems is that the efficiencies of the power-conversion-package components rise with power level. The rise in turbine efficiency with power level is illustrated in Fig. 4, where the points shown are designs developed by Thompson Ramo Wooldridge, Inc. In the case of SNAP I and Sunflower I (essentially the same as SNAP II [5]) the design methods are substantiated by extensive test results. The solid line indicates current designs, the dashed line indicates the efficiency-power level relationship resulting from expected further developments and design refinements.

The efficiencies of alternators also increase with power level. Alternator efficiencies reach 90 per cent at the 10-kw power level, increasing from 83 per cent at 3.5 kwe to approximately 93 per cent at power levels above 250 kwe [6].

For small power-conversion systems, in the range discussed here, the turbine-alternator unit weight is determined largely by pressure level and fabrication considerations, not by the characteristics of the turbine and alternator. As the power level rises, the weight of the alternator becomes significant, since it depends on the rotational speeds possible [7].

Heat-Rejection Subsystem. The Sunflower I heat-rejection subsystem consists of a directly radiating condenser, a subcooler, and heat exchangers using a small portion of the waste heat to preheat liquid mercury flowing to the boiler. The condenser-radiator consists of two large fins in the same plane, mounted between the collector and the boiler-heat storage unit, one fin on either side of the optic axis of the system, Fig. 1. Attached to each fin are six tapered tubes carrying the power-conversion-system working fluid. The unit radiates from both sides. The turbine exhaust is ducted to the collector end of the fins where headers distribute it to the condensing tubes.

The tubes are manifolded together at the "outboard" fin ends, and the last 1 per cent of the vapor is condensed in a heat exchanger, which transfers this heat to the liquid mercury being delivered to the boiler. The design has been substantiated by laboratory tests and airplane zero-gravity tests made in conjunction with the Air Force Wright Air Development Division [8].

Some of these design methods have been described in the literature [9]. The Sunflower I condenser-radiator rejects 26.6 kw at a temperature of 580 F. It has a total radiating area of 107 sq ft and a weight of 42.9 lb, for a weight per unit area of radiating surface of 0.40 psf. These numbers are based on a 95 per cent probability of no meteorite puncture in one year. If a 99 per cent probability of a one-year life is required, the weight increases to 62 lb. For a radiator configuration which can radiate from only one side, the specific weight would be doubled.

For larger-power Rankine-cycle svstems, an indirect radiator-condenser subsystem replaces the directly radiating condenser of the Sunflower I system. In this method of heat rejection, the working fluid is condensed in a compact condenser, the heat given up being transported to the radiator by a circulating coolant. A fluid such as Dowtherm can be used for this purpose. This heat-rejection subsystem becomes attractive at power levels between 10 and 15 kw. The advantages are:

1 It allows a more flexible design arrangement of the radiator.

2 Simplified ground testing using the compact condenser.

3 Simplified zero-gravity condensation.

4 Very small headers and tubes are required.

The Multiple Package Approach

One method of developing a family of power-conversion systems based on the Sunflower concept is to use multiple turbine-alternator packages to produce more electric power. The advantages are:

1 Development time is reduced.

2 A system reliability is increased since the failure of one package reduces the total power output, but does not result in the entire system becoming inoperable.

Disadvantages are:

1 Total system weight is nonoptimum.

2 Startup and control may be more complicated.

Turbine-alternators in parallel feeding the same network are, of course, standard commercial practice, and as boost capability increases, weight becomes a less important criterion in assessing the merits of power-conversion systems. The increased reliability is certainly an attractive factor for multiple-unit power-conversion systems, but it is felt that the major consideration in determining whether this approach would be used will be development-time requirements. A larger power-conversion system could be readily synthesized, using a number of the turbine-alternator packages which have already achieved near-operational status.

The multiple turbine-alternator-package approach to the design of larger power solar power-conversion systems results in rather large system weight, as was expected. The specific weights may be compared with a high-temperature Rankine-cycle dynamic engine system design described in the literature [10], using rubidium as the working fluid and operating between 1750 and 675 F. This design has a specific weight of 55 lb/kw, but an extensive development program would be required to bring it to flight status, as no technology exists on which to base the design and fabrication of the components.

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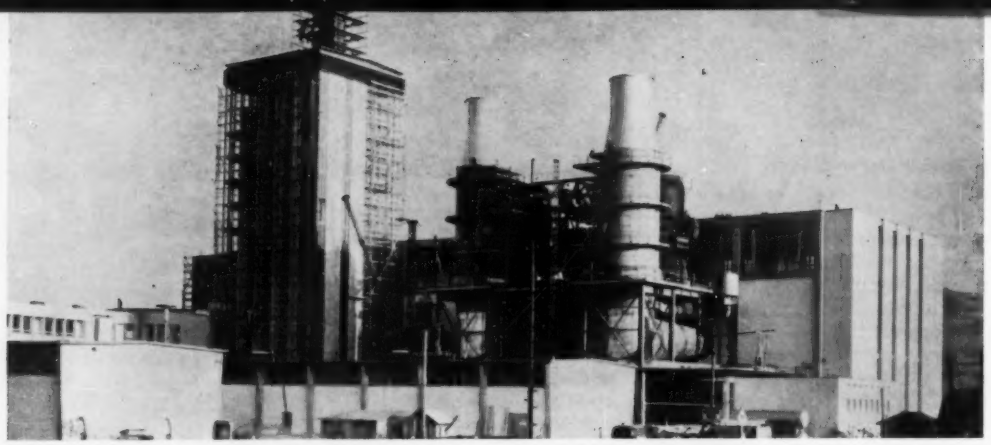

View of thermal power plant, Korneuburg, Vienna. **At left,** boiler of 70/77-mw steam-turbo block (under construction). **At right,** waste-heat boilers of two gas-turbine sets with the preheater and evaporator vessels in foreground.

USING the gas turbine's HEAT

By Werner P. Auer,[1] Brown Boveri and Co., Ltd., Baden, Switzerland

Efficient as it is, the gas turbine offers possibilities of still greater economies when its heat is recovered—for steam power, or for industrial heat. Here are four plants, four solutions.

THE combined processes of the four plants described in this paper are not identical, but in all cases the utilization of the exhaust heat of gas turbines results in considerable improvement of the efficiencies. Operating experience, where already available, confirms the expected results and proves that the decision to install a combined plant was correct.

Two 25/30-Mw Turbines

The first system is a thermal power plant in Korneuburg, Vienna. Basic equipment is two 25/30-mw sets of double-shaft open-cycle gas turbines burning natural gas [1, 2].[2] Although these turbines have a relatively high efficiency, a means was sought to improve performance further by utilizing the exhaust gas. To do this, each turbine sends its exhaust gas to a waste heat boiler which in turn supplies steam to a turbine.

This arrangement, however, could only produce low live-steam conditions which would have resulted in a small heat drop with a low efficiency. It was therefore decided to increase the temperature and pressure level of the steam by supplying additional heat through a superheat boiler. The steam could then effectively operate the exhaust-heat steam turbine, a reaction-type machine with a rated output of 25,700 kw. See Fig. 1.

Over-all efficiency of the combined plant at an ambient temperature of 32 F is expected to show an improvement of 18.5 per cent over the gas turbines alone.

Burns Blast Furnace Gas

The second example is the Cornigliano Steel Works in a suburb of Genoa, Italy, which has a 16,000-kw single-shaft gas turboset burning blast furnace gas [3].

There is no heat recuperator on this machine; instead, it will exhaust into a waste heat boiler. The necessary live-steam temperature would not have required an additional heat supply. However, a burner will be provided to slightly increase the gas temperature. This will allow a smaller heat-transfer surface in the boiler.

Temperature of the feedwater returning from the steam system is too high to allow the cooling of the exhaust gases to the lowest possible temperature. Therefore the waste heat boiler, in addition to the steam section, contains a water heater which supplies 23.8×10^6 Btu/hr to an existing hot-water system.

Thermal efficiency of the gas turbine, referred to the generator terminals, is 18.6 per cent under full load at an ambient air temperature of 59 F and based on the lower heat content of the fuel. On the other hand, the steam generated in the waste heat boilers produces an additional output of 11,150 kw in the existing steam turbines. Fig. 2 shows the combined cycle.

Reduced Fuel Consumption

Example three comes from the Dudelange Steel Works, Luxembourg. Besides providing electric power there is a high consumption of steam and heat at this plant. The existing power plant was a 5400-kw gas-turbine set. This was combined with a system consisting of a 143,325-lb-per hr boiler and a 13,300-kw double-cylinder, double-pressure steam turbine [4].

Exhaust gases of the gas turbine are used as combustion air for the boiler, considerably reducing fuel consumption. About 17 per cent of the gases leaving the recuperators of the gas turbine at a temperature of about 430 F are consumed for this purpose. The remainder of the exhaust gases are used to heat feedwater. Increased efficiency of the gas turbine more than offsets the reduction in steam cycle efficiency caused by more steam flowing to the condenser.

An over-all performance of 27.4 per cent for the combined plant was obtained in actual operation. The gas and the steam turbines were fully loaded but no steam was sent into the heating system or supplied to the turbines from the accumulators. Efficiency for the gas turbine was 20 per cent and 24 per cent for the steam turbine.

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[1] Chief Engineer, Gas Turbine Sales and Application Engineering Dept.

[2] Numbers in brackets indicate References at end of paper.

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Fig. 1 Diagram of the waste-heat and superheater boiler of the combined gas turbine/steam plant at Korneuburg, Vienna. This system includes two 25/30 double-shaft turbines and a 25,700-kw steam turbine.

Provides Central Heating

The last example is a public utility company supplying electric power and heat to a town of 40,000 people. It is located in a new suburb of Bremen, Germany.

There are two gas turbines in this system along with hot-water accumulators, four oil-fired boilers (24.2×10^6 Btu/hr), and four electro boilers (10.3×10^6 Btu/hr) [5].

For best performance, as much heat as possible must be drawn from the gas turbosets. Therefore exhaust heat is recovered not only through waste boilers but through the intermediate coolers which are of a special divided design. They permit the extraction of heat from the first (hotter) section and the use of fresh cooling water for the second (colder) one. With this arrangement each intercooler produces about 47.6×10^6 Btu per hr. In addition, valuable cooling water can be saved because only 40 per cent of the heat to be extracted from the combustion air has to be removed with fresh water.

In exceptional cases where the gas turbines would run without producing heat for the homes, the heat extracted from the first intercooler section can be transferred to cooling water in an auxiliary cooler.

Heating water from the intercoolers is piped to the waste heat boilers where it picks up another 71.4×10^6 Btu per hr and per gas-turbine set. It then flows back to the heating system at a temperature of 230 to 266 F.

As mentioned, there are oil-fired and electro boilers in addition to the turbines. Separate heat exchangers transfer their heat to the hot-water system.

The two gas-turbine sets are rated at 25 mw at ambient conditions of 34.7 F and 14.7 psia. Thermal efficiency at these conditions and at full load is 24.5 per cent. Design temperature is 1157 F. Exhaust gases leave with a temperature of about 605 F at full load and are cooled in the waste heat boiler to about 355 F. The turbines are similar to those in the first example with the exception that they burn oil and have the divided intercooler.

It is hoped that the four examples of gas turbines combined with a steam or industrial cycle will promote the idea of the combined process and encourage the execution of more similar installations.

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Fig. 2 Cornigliano Steel Works uses a single 16,000-kw turboset to supplement the existing steam system. The gas turbine has an efficiency of 18.6 per cent.

Fig. 1

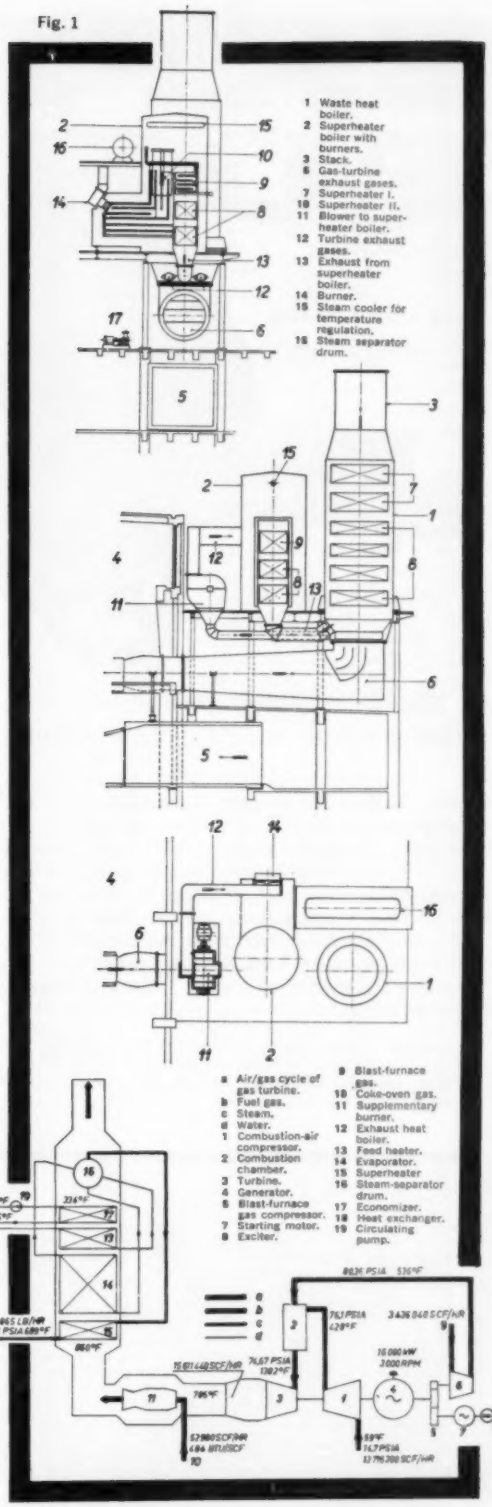
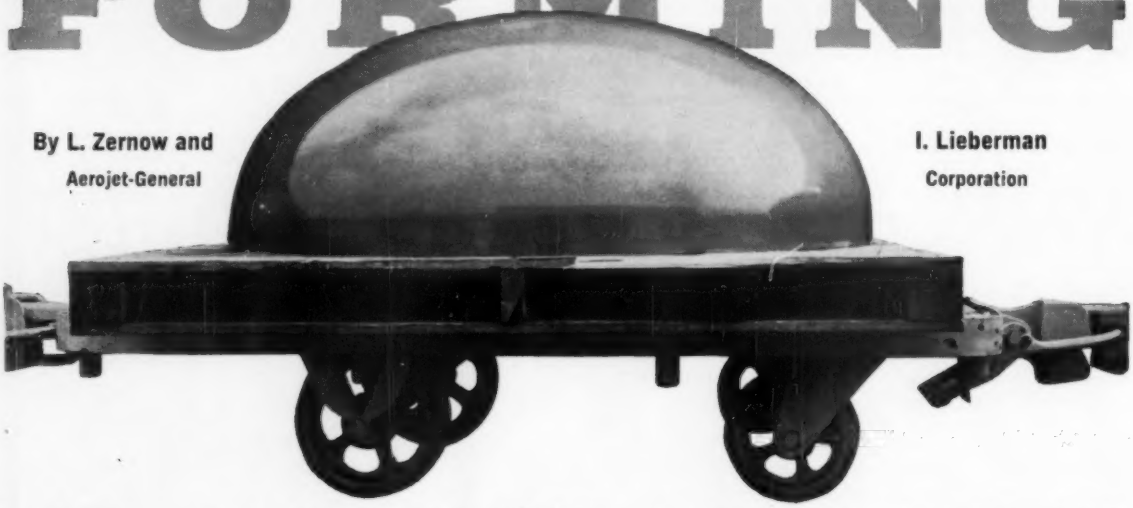


Fig. 2

EXPLOSIVE FORMING

By L. Zernow and I. Lieberman
Aerojet-General Corporation



Its advantages presage wide use — it is definitely a production process — but costs and limitation must be understood. Now there are also explosive welding and joining techniques.

ENGINEERS have known for many years that explosives could be used to deform metals. The earliest patents on the subject were taken out prior to 1900. However, only within the past few years has explosive metal forming developed into a process that is competitive with conventional metal forming.

The new formidable fabrications needed for the age of space and missiles have been responsible for focusing attention on explosive forming. There are three general problem areas:

Condensed from a paper contributed by the Production Engineering and Machine Design Divisions and presented at the Summer Annual Meeting, Los Angeles, Calif., June 11–14, 1961, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

- Metal parts are so large that conventional facilities cannot keep up without vast expenditures for capital equipment.
- The materials are specially selected for high strength/weight ratio and in many cases require exceptional heat-resistance capabilities. These materials are difficult to fabricate.
- The current practice of compressing research, development, and production into virtually concurrent operations puts a premium on the ability to make changes economically and rapidly.

Unfortunately, the "Madison Avenue" type exploitation of the glamorous aspects of explosive metal forming

EXPLOSIVE FORMING AT GENERAL DYNAMICS

An engineer positions the explosive that will blast the sheet-metal cone into a precise form. The ½-oz charge of dynamite is suspended above the die just under the surface of the water so the shock waves will hit the metal with the right force to push it into the shape of the die. When all is ready, they push a button, a plume of water shoots from the forming pit, and in a split second an intricate missile part has been made from sheet-metal. If the same part had been made using the regular production line methods, three or more dies would have been needed.

has resulted in the dissemination of incorrect information as well as much sheer nonsense on the subject. Those who attempt to fabricate hardware on the basis of such nonsense will come face to face with the hard economic facts of life.

On the other hand, explosive forming has indeed become an economically competitive process in the space age, especially in areas related to rocket manufacture.

The Process

In the explosive forming process, a high explosive is detonated, and its energy is transmitted through a fluid medium (commonly water) to a workpiece held on a female die. The space in the die behind the workpiece is usually evacuated to avoid adiabatic compression and heating of the entrapped air. (If not controlled this could result in burning the rear face of the workpiece and die.)

The energy transfer medium need not be water. Hot forming calls for molten salts, molten metals, sand, oil, or other media which can sustain the desired forming temperature. Air can also be used as an energy transmission medium. Many other media are possible, but, for the cold fabrication of large workpieces, from the viewpoint of cost and convenience, air and water are the most suitable. Water is superior because of its reduced compressibility and better shock-impedance matching characteristics.

Underwater detonation of a high explosive yields a shock wave and a bubble of hot gaseous detonation products. The shock wave is the major energy source in this process. Secondary bubble phenomena are normally neglected in the first-order analysis, because these explosions occur at relatively shallow depths, sometimes so shallow that the bubble breaks through the surface of the water. The secondary shock-wave reflection effects, from the water surface and from the tank wall, modify the simple analysis somewhat. This is not a serious problem since any work tank can be calibrated to include these secondary effects.

In general, any homogeneous explosive of reasonable sensitivity is suitable as an energy source, such as dynamite and liquid explosive. However, there appear to be no major advantages from explosives with high detonation velocity. The charges needed for explosive forming work are small, ranging normally from $^1/_4$ lb to less than 10 lb.

Explosive Correction and Explosive Forming

The term explosive correction (or explosive sizing) is applied to the process in which an out-of-tolerance part or a preformed part is explosively deformed to its desired final configuration. Although explosive forming includes explosive correction as a special case, in general, forming is applied to the fabrication of a part from a flat sheet material.

Explosive correction was one of the earliest applications, since it was most appropriate for salvaging parts that did not meet the tolerance requirements after fabrication by conventional methods. There are a number of rocket hardware components that can suffer from such troubles. A common one involves the deviation from desired diameter and contour in the dome or the pressure-vessel closure. A poor match between dome and cylinder causes serious assembly problems. Another common trouble is distortion of the dome after the bosses are welded on. Both problems have been satisfactorily handled with explosive correction techniques. Explosive correction is a process applicable not only to the pressure-vessel closures but to the complete pressure-vessel assemblies as well.

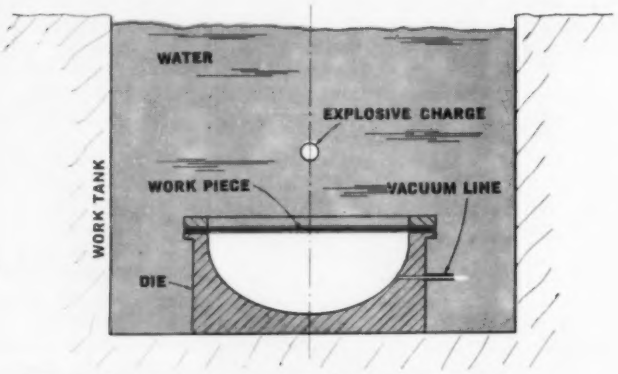
Explosive forming from flat sheet is a more complex process than explosive correction. It is interesting, however, to realize that, despite its greater difficulty, explosive forming from flat sheets is, over-all, a more economical process for fabricating pressure-vessel closures than the process involving conventional drawing followed by explosive correction. In the explosive forming process, as applied to the fabrication of domes, the main process steps are: explosive forming, deflanging, and explosive correction.

The surface of the initial sheet is specially prepared by grinding if the thickness tolerances are held closely. Final thickness control depends on the proper combination of explosive charge geometry, die hold-down pressure, and the initial surface preparation.

The explosive forming of welded sheet is possible if the weld is of good quality, such as a machine weld on AMS-6434. A poor weld will not stand up.

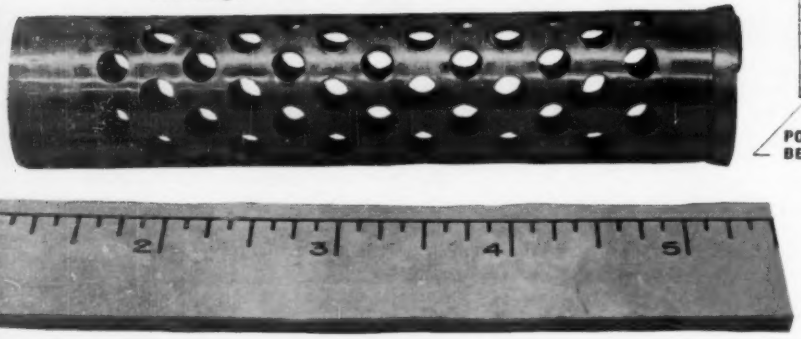
A good way to evaluate the quality of a product made by explosive forming methods is to indicate the tolerances in diameter, contour, and thickness which can be obtained by this technique. A typical dome of AMS-6434, ranging from 40 in. to 60 in. in diam, and ranging from 0.080-in. to 0.150-in. in thickness, with an

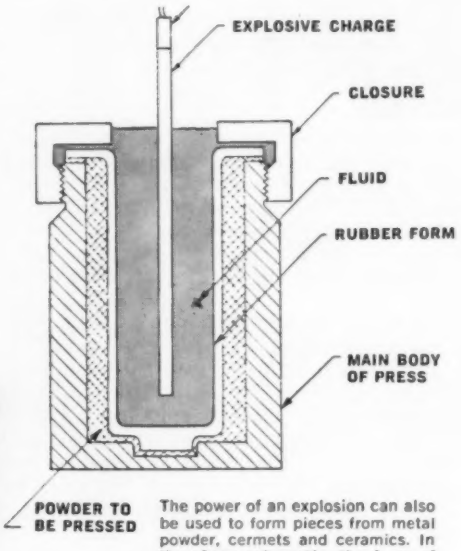
EXPLOSIVE FORMING



A typical explosive forming setup is shown in the diagram, at left. An explosive charge sends shock waves that push the workpiece into the shape of the die.

With certain variation in the design of the die, the explosive force can be made to cut the metal instead of forming it. Here is a multi-perforation of a 4130 steel cylinder done by an explosive charge.





The power of an explosion can also be used to form pieces from metal powder, cermets and ceramics. In the above schematic, the force of the charge hits a rubber form that in turn compresses the powder.

A completely assembled explosive forming die is being lowered into the 30-ft diam tank. Dies of various sizes are lined up at the assembly building in the background.

elliptical cross section, can be fabricated with the following tolerances.

DIMENSION	TOLERANCE	
	Normal	Possible
Diameter	± 0.010 in.	± 0.005 in.
Contour	± 0.020 in.	± 0.010 in.
Thickness	± 0.004[a] in.	± 0.002[a] in.

[a] Surface preparation required.

Cost Reduction

There are many areas under investigation which hold promise for cost reduction in fabrication of rocket chambers and other rocket components. The following are five examples.

Integral Bosses. Bosses on rocket chambers represent an important area for cost reduction. The usual method for obtaining such bosses involves three-dimensional machining. In using explosive forming, sheet contour can be prepared while the sheet is flat. Therefore relative preparation costs can be far smaller than the costs of contouring after forming. If the sheet is appropriately contoured while flat, the bosses can be machined by normal methods. Studies carried out up to this time show the feasibility of such boss fabricating, but the full evaluation must await more detailed and specific studies.

Thickness Control and Tapering. A requirement often arises for a nonuniform thickness distribution in the dome of a rocket engine. There are explosive forming techniques that make domes with a prescribed radial thickness taper or any reasonably smooth nonaxially symmetric thickness variation. One of the most fruitful areas for application of this technique is in nonaxially symmetric thickness distributions that usually require 3D machining.

Explosive Forging. When substantial thicknesses of materials have to be deformed, the process is more accurately described as explosive forging. Thus, when a flat 4-in-thick aluminum alloy (7075-0) plate has to be deformed into a dome shape, it is often best to carry out the process in successive steps. There are two intermediate anneals, one after the second, and one after the sixth deformations, respectively. These deformations were carried out cold. Conventional forging equipment could not accomplish the required deformation. It is also probable that the forging could be made in three shots rather than nine. A side advantage is that substantial hardness changes occur in the initially soft alloy. Thus, in the fabrication of a 4-in-thick closure with only a $7^1/_2$-in-deflection at the center, the hardness increases from 6 Rockwell B to 20 Rockwell B (about 55 to 68 on the Brinnell scale).

Explosive Perforation. In the very earliest work on explosive forming it was found that material could be formed smoothly or cut depending on the shape of the die cavity lips. Both forming and perforation could be done on the same workpiece so the two operations could be carried out in one shot. As an additional advantage, there is no burring on the interior of the perforated cylinder. In the economic analysis of this process, the die life plays a very important role. As in all explosive forming work of a repetitive nature, the highest skills of the die designer must be applied or the potential economic advantages will be lost.

Hot Explosive Forming. Some materials which normally require heating prior to forming by conventional methods can often be formed at ambient temperatures in explosive forming. Although this is true for a few materials, there are many that are too brittle at normal temperatures to deform to a useful extent. For such materials, explosive forming under elevated temperature conditions is not only possible but also advantageous. The material can be heated by contact with heated solid or liquid media, or in some cases by chemical reaction in the medium contacting the workpiece. The undesirable oxidation process which may adversely affect the final product in some cases can be prevented by an inert atmosphere.

Although it is easiest to apply hot explosive forming to small workpieces, it will work for large pieces as well. The main disadvantage will be the additional cost of the equipment and the additional safety requirements. The biggest advantage is the ability to produce a part which is otherwise not attainable at the same cost or not attainable at all.

The ability to shape materials such as tungsten has definite applications to the rocket engine problem. Nozzles are needed to withstand the ever-increasing gas temperatures. The ability to shape materials cleanly and cheaply, like molybdenum, tungsten, columbium, and tantalum will provide the answer.

Explosive Compaction

In the past three years investigators have become interested in the problems of explosive compaction. The work described here is concerned mostly with the explosive compaction of refractory metal powders, although there has been a good deal of work on other systems including cermets and ceramics.

Explosive compaction has the following advantages:

- Extremely high pressures can be applied.
- The area of the object being pressed is not limited by the maximum total force as it is in the case of a hydraulic piston press.
- Very high densities are possible. These range up to 96 per cent of theoretical density obtained with tungsten and molybdenum.
- Shrinkage on sintering can be markedly reduced by virtue of the high green densities attainable.
- Final expensive finishing operations can be drastically reduced since the finish obtained often precludes the need for further refinishing.
- Mixtures of metals, ceramics, cermets, and graphic materials can be compacted.
- Layers of dissimilar material can be bonded.

Other Explosive Techniques

Explosive welding as well as explosive joining are also of interest. However, they are at present considered to be appropriate under circumstances where normal welding and joining are either too difficult, too slow, or too expensive in terms of weight of equipment. Consider the assembly of a space station in orbit. It would certainly be an attractive weight saving to use high explosives for the welding process rather than carry the full welding system into orbit.

Explosive joining has already found industrial application in commercial areas. Although it is not as yet an industrial production technique, there is little doubt that it will find an appropriate role in the future.

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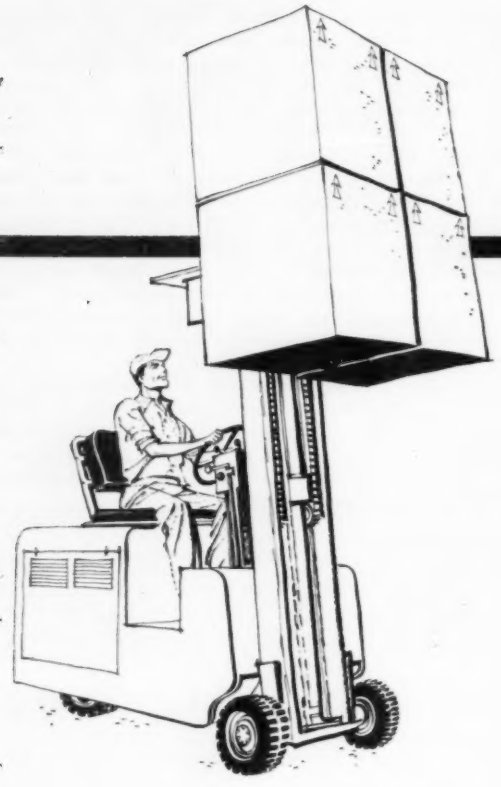

Measuring

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A systematic approach to recognizing and reducing material-handling costs. Work measurement gets at the true causes of excessive time.

INDUSTRY is a mass flow of materials from raw product to the ultimate consumer in which the materials are moved and handled many hundreds of times. The cost of this material handling represents a large proportion of the total cost of the end product and provides many opportunities for significant savings. Unfortunately, too many companies recognize only certain parts of the over-all handling system as providing scope for cost reduction. Too few companies use a systematic approach to reducing handling costs. Proper measurement of handling operations can provide the facts on which to base methods improvement, justify capital expenditures, and plan new manufacturing and storage facilities. There are many recognized measurement techniques for the study of material handling which are not being applied.

What Is Material Handling?

It is necessary to recognize, first, that a material-handling operation exists whenever material is being moved. Although this is a simple and obvious statement, worth-while opportunities for cost reduction are frequently missed because the handling operation is a hidden part of a larger and more obvious operation.

Transportation, receiving, warehousing, and shipping are normally referred to as material-handling operations. But it should be recognized that all movement of materials between manufacturing departments, within the departments, and at the individual workplace, whether by fork-lift truck, hand truck, conveyer, or by hand is part of the over-all handling system.

Handling material at the individual workplace is probably the least recognized and most seldom considered part of an over-all handling system, yet it is the most expensive part in some companies. The extent of the handling at the workplace can be significantly affected by the method used to supply material to the operation and dispose of it. Likewise, the design of production machines, tooling, and general workplace arrangements can have a big influence on material-handling costs.

Work Measurement

Frequently, improvements are made in material-handling operations with relatively little prior study, since the scope for improvement is so obvious that detailed analysis is unnecessary. While this approach is justified in a number of cases, it can lead to unwarranted capital expenditure in others.

In a case where a company had ordered a rather exten-

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sive conveyer system for a warehousing operation without proper study, a short systematic analysis by the writer proved that costs would be higher with the proposed conveyer operation. A simpler manual-handling system was developed and a relatively large capital expenditure was avoided.

In another instance a substantial addition costing several hundred thousand dollars was made to an electric-furnace installation to increase plant capacity. If the handling methods used to supply and remove material from the furnaces and other operating procedures had been improved in the old facilities, the productive output of the existing equipment would have been increased to the point where this large capital expenditure could have been delayed for several years.

Work measurement of material-handling operations provides the facts with which to properly analyze proposals for many capital expenditures. Extensive use can also be made of work measurement techniques in studying existing operations to determine the scope for improvement. Such studies draw attention to operations that should be changed and establish the relative cost of handling activities. They thus provide a technique for measuring possible economies and evaluating alternative proposals.

Work Sampling. Certain types of material handling are difficult and often relatively expensive to analyze in detail, operation by operation. Fork-lift-truck and bridge-crane operations frequently take place over relatively large areas requiring an observer to spend much time traveling in order to observe short operations at each end of a trip. Certain elements of other handling work cycles have a long duration, and still others occur infrequently, again making precise measurement expensive. The speed of travel of some equipment such as fork-lift trucks makes it difficult to study all operations accurately. Where material handling is only part of the over-all work content of many jobs, it is expensive to study all of these jobs in order to analyze the handling activities. In these cases the technique of work sampling is often ideal.

Work sampling consists of taking instantaneous observations of material-handling activities at random times and recording these observations in predetermined categories, Table 1.

After sufficient observations have been made to insure reasonable statistical accuracy, the proportion of time being spent on the separate categories of work will be indicated and steps can be taken to improve the operations.

To make the fullest use of such studies, it is necessary to have the categories broken down fine enough for the true cause of excessive time to be determined. If a category such as "paperwork" were broken into scan order sheet, mark order sheet, mark bin tags, prepare labels, write-up bills of lading, and so forth, it might indicate that a high proportion of time was being spent on a single operation such as preparing labels. The use

Table 1 Examples of Categories for Work Sampling

Fork-lift trucks	Stores personnel	Production-machine operators
Travel empty	Walk empty	Operate machine
Travel loaded	Handle material	Move material at workplace
Lift or lower load	Push truck loaded	Move material to or from workplace
Pick up and dispose of load	Push truck empty	Wait for material
Receive instructions	Paperwork	Set up and adjust
Idle time	Receive instructions	Inspect material
	Idle time	Receive instructions
		Idle time

Table 2 Work-Sampling Study of Warehouse-Crew Performance

Operation	Percentage of time
Move goods to packing tables	14.1 per cent
Obtain and prepare containers	7.4
Pack goods	16.6
Wrap goods	15.4
Tie or strap parcels and containers	24.3
Paperwork	12.4
Move goods to dock	9.8
	100.0 per cent

Table 3 Predetermined Times for Basic Movements

Motion	Time, ten thousandths of a minute
Move leg (1 to 6 in.)	50
each additional inch	2
Move foot (depress pedal)	55
Side step with one foot (1 to 6 in.)	60
each additional inch	2
Walk one pace	100
Turn body to one side	110
Bend or stoop	180
Sit	220
Stand	270

Table 4 Work-Sampling Study in a Woodworking Shop

Activity	Percentage of Time
Trucking material between operations	4.8 per cent
Operating machines	36.2
Handling material at the workplace	36.7
Setup	4.6
Miscellaneous operations	17.7
	100.0 per cent

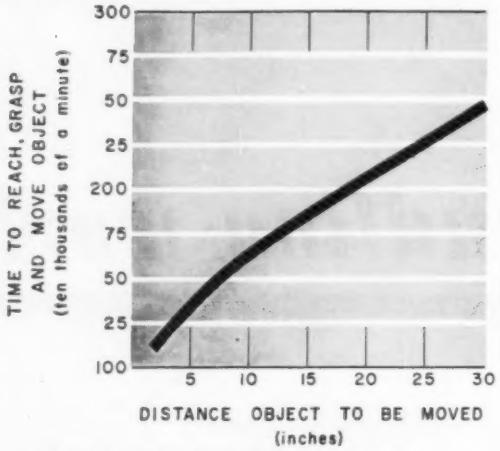

Fig. 1 The effect of distance on the time required to manually move a 2-lb object. The hand moved an equal distance to and from the supply point.

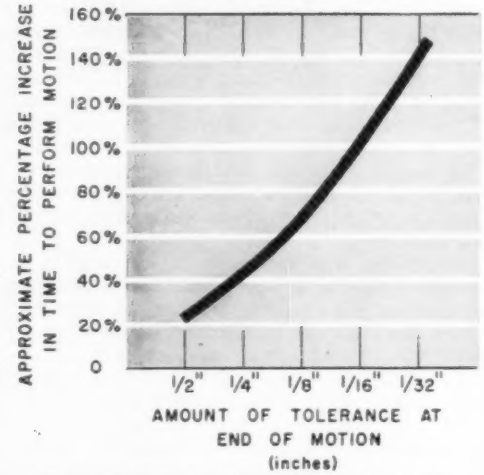

Fig. 2 The effect of precision on the time required to perform a motion. The times required relative to tolerance were derived from BMT data and are expressed as a percentage increase in time over that required of a motion not affected by precision. Percentages are approximate since they represent an average of various motion lengths, each affected differently by tolerance at the end of motion.

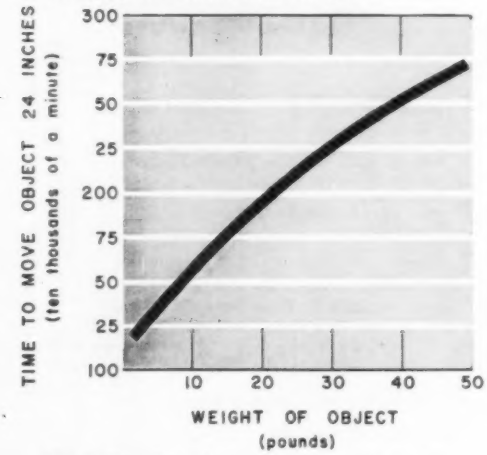

Fig. 3 The effect of the weight of an object on the time required to lift it, move it 2 ft, and set it down

of precut stencils or preprinted labels could be considered.

Work-sampling studies can be used to determine whether material-handling equipment is being utilized effectively. When the level of production was to be expanded significantly in a 1,000,000-sq-ft manufacturing plant it was assumed that about five new fork-lift trucks would have to be added to a fleet of 40 to accommodate the increased material-handling workload. Work sampling indicated that some trucks had excessive idle time. Others traveled empty a large part of the time and for long distances. Crowded aisles delayed trucks at some points. Other trucks were ineffectively utilized even though they were controlled by radio from a central dispatcher. Improvements in the planning and control of truck movement not only made it unnecessary to purchase new trucks to take care of the increased workload but permitted one old truck to be retired without replacement.

Work-sampling studies can also be used effectively to study the performance of crews in material-handling work. A study of a warehouse packing crew, consisting of up to 12 men, was carried out prior to the design of a new warehouse, Table 2.

This information and other more detailed work-measurement studies permitted the paperwork, wrapping, and strapping methods to be improved. Furthermore, a conveyerized workplace arrangement was designed for the new warehouse which practically eliminated the manual movement of goods in packing. Eight workplaces were provided in the new operation and the normal complement of the crew was reduced from ten to six, a reduction of more than one third.

Work sampling can also be used effectively to study a number of operations taking place at workplaces in a small shop.

Stopwatch Time Study. Stopwatch time study is a much more detailed method of measuring material-handling operations which provides accurate information on the time required to perform each of many individual elements of an over-all work cycle. Those elements that are proportionately large and offer the greatest opportunity for economies will stand out. Readings are normally made in hundredths of minutes and as a rule only one operation at a time is observed. The close analysis of all the activities that take place frequently uncovers opportunities for improvements that would be missed in casual observation.

Time study can be used most effectively to measure the length of relatively short elements of a material-handling operation. It can also be used effectively to measure the proportion of time being spent on handling materials as part of a production operation. A conveyer to move units between several assembly operations was found unnecessary when time study revealed that only about 6 per cent of the time of the assembly crew was being spent on moving the units. The remainder was absorbed by work that would not be reduced by installing a conveyer and the other benefits which result from conveyerized assembly were insignificant.

Time study can also be used to establish effective work standards for controlling the costs of many handling operations. Another use is to predict staffing requirements where fluctuations take place in the handling workload.

Predetermined Time Data. An even more detailed approach to measuring material-handling work performed manually is the use of predetermined motion, time, data sys-

tems such as Basic Motion Time Study, BMT.[1] This system was developed from an exhaustive study of the basic movements of fingers, arms, body, and legs. Standard times were developed for each separate type of body motion over varying distances with appropriate allowances for applications of pressure or force and for precision. Times were also developed for eye movements to provide time allowances for focusing and reading.

The predetermined times of BMT are expressed in ten thousands of a minute, Table 3. For example, the standard time required to simply move the hand back and forth in the air 10 in. in each direction is 0.0128 min.

Among its many applications, BMT is used to analyze and develop times for operating machine tools and other types of production equipment, or manually controlling the operation of material-handling equipment such as hoists and fork-lift trucks. This system is particularly applicable for studying the manual handling of material on and off conveyers, to and from production equipment, and for assembly work.

BMT can be used not only to study existing operations but also to analyze alternative proposals. The individual motions required to perform the proposed operation are listed in sequence, time values are determined for each, and an over-all time for completing the work is established. This provides a relatively simple method of evaluating proposed workplace arrangements or handling methods and avoids the expense of making experimental setups or fabricating or purchasing equipment for trial purposes. Predetermined time data can also be used to provide the factual information with which to justify capital expenditures. Where individual motions do not take long enough to permit separate measurement by work sampling or stopwatch but are repeated hundreds of times in a day, their cumulative effect is a significant cost. Predetermined time systems such as BMT can be used to measure these motions accurately and provide sound information on which to base methods-improvement work.

Handling at the Workplace

Unfortunately, many companies still do not recognize that a great deal of time spent at the individual workplace is devoted to moving materials from the supply point to the position where the operation is performed, and then to the point of disposal. In many press operations, for example, the proportion of the elapsed cycle time absorbed by the movement of the part to and from the die is far in excess of that spent in positioning the part or in operation of the machine.

The data obtained with a work-sampling study in a woodworking shop, Table 4, indicated clearly that although economies would be made by reducing the handling between operations, much attention should be given to minimizing handling of material at the workplace. Comparable figures would result from similar material-handling work-measurement studies in many metalworking shops. It is most important to recognize that during the time that a large proportion of this material handling is performed at the workplace, the production equipment is inoperative. Thus a reduction in handling also increases the productive output of the operator and equipment.

To deal effectively with material handling at the workplace, this work should be considered as part of the over-all handling systems and not a separate sequence of operations. Containers, racks, conveyers, and other equipment should be designed to minimize the distances that material must be moved at the workplace. Much can be done to reduce the time of handling work by shortening these distances. The effect of reducing the distance that the hand must travel to grasp a part and move it to a work position as developed from BMT data is shown graphically in Fig. 1. In this example the hand moves an equal distance to and from the supply point and the object to be moved weighs less than 2 lb. A reduction from 30 to 12 in. in the distance to be moved produces a time saving of about one third.

In this example, it is also assumed that the hand moves in a reasonably straight line or sweeping motion. However, if it were necessary because of the design of a container to move the hand over the container and then into it, two movements would take place. If this double motion were duplicated after the part was grasped, the over-all handling time would be increased by about 50 per cent. Likewise, a relative increase in handling time of about 25 per cent can result at times if a part is unhooked from an overhead conveyer instead of being removed from a supporting tray. The way in which a motion will end is also important. It is common practice after an operation to place parts on a truck, on a rack, or in a container. However, if the part can be tossed, a reduction in the handling time of well over 20 per cent can be achieved. The use of containers into which the parts can be tossed, or conveyers on which parts can be dropped, should be considered in establishing handling procedures. Automatic ejection of the part from the machine into a container is another possibility.

When designing production or handling equipment, the degree of precision required to place the part is important. Extra care and therefore extra time are required to fit parts together or place parts in a confined area when tolerances are close, Fig. 2.

Punching or piercing dies for example, may be equipped with funnel-like entrances to facilitate placement of the material. Forming dies may have rests or stops against which parts can be placed without the extra care required for accurate locating. Jigs may have chamfered corners at the entrances.

The weight of the material to be moved is also important, Fig. 3. When the weight of objects to be moved increases beyond a relatively low point, serious attention should be paid to the manner in which the object is handled. It will take about 35 per cent longer to pick up an object that weighs 10 lb, carry it 2 ft, and set it down again than to carry it 2 ft and drop it. If the object can be pushed aside about 2 ft by sliding, the time will be about 30 per cent less. Of course, moving the object on a roller conveyer would reduce the time required to perform the operation even further.

Conclusion

Whether for the detailed examination in ten thousandths of a minute of handling methods at a workplace —the microscopic approach—or for the study of fork-lift truck operations by work sampling, work-measurement techniques can be applied to analyze material-handling operations effectively. Instead of reaching for something new, many companies should be making use of these well-proved methods to systematically study their handling activities, particularly those at the workplace.

[1] Gerald B. Bailey and Ralph Presgrave, "Basic Motion Timestudy," McGraw-Hill Book Company, Inc., New York, N. Y., 1958.

At the Enrico Fermi nuclear plant—in Italy's Po valley—a steam-reheater will reduce

STEAM REHEATER for

By F. W. Gettler, Jr. and J. H. Potter[1] Mem. ASME,

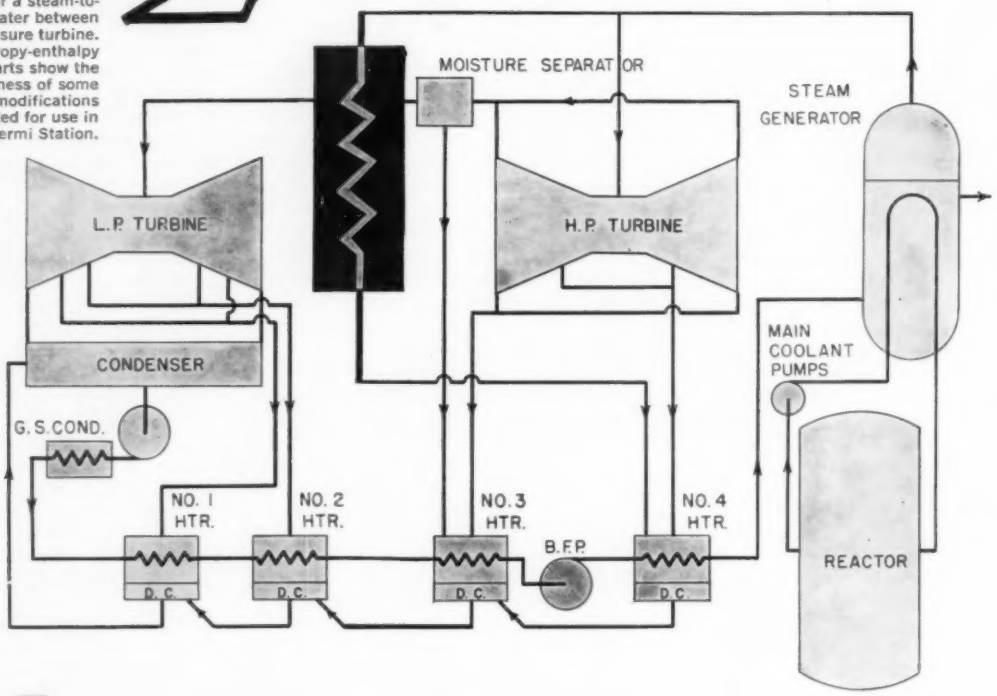

Fig. 1 The flow diagram for the Enrico Fermi Station is distinguished by the inclusion of a steam-to-steam reheater between the high and low pressure turbine. These entropy-enthalpy charts show the effectiveness of some of the modifications suggested for use in the Enrico Fermi Station.

THE Enrico Fermi Nuclear Power Station of the Società Elettronucleare Italiana, SELNI, to be built in Italy's Po valley, will add 176,000 kw to an existing power network. After a preliminary study of most conventional reactor systems, including fossil-fuel-fired superheating [1, 2],[2] an all-nuclear-powered pressurized-water reactor was chosen, Fig. 1.

In addition to such conventional items as steam separators and regenerative feedwater heating, the cycle is distinguished by the inclusion of a steam-to-steam reheater between the high and low-pressure turbines. The application of this type of reheater in a nuclear cycle is unique and of sufficient interest to merit more detail on the reasons for its selection.

Background

At present, because of limitations within the reactor section of the plant, nuclear power cycles use saturated steam, and many of the problems of the presuperheat era for fossil-fired stations are being encountered again. The saturated-steam turbines for these cycles require great care and attention to design problems [3, 4].

To handle large quantities of wet steam at moderate rotative speeds, long blading and large wheel diameters are necessary. In the flow of wet steam, the moisture droplets move at a velocity lower than that of the vapor. This affects the vector relationships in the nozzles and blading, decreasing the work of the stage and reducing

[1] Consultant.

[2] Numbers in brackets designate References at end of paper.

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the cost per kw and increase turbine life

Nuclear Station

Gibbs and Hill, Inc., New York, N.Y.

the stage efficiency. With time, erosion by the water particles distorts the steam-flow passages and weakens the blades. A 12 to 15 per cent increase in moisture content decreases blade-life expectancy from 10 to 6 yr. [5].

Of the many investigators of this problem, Baumann suggested that there was a loss of energy conversion in the stages proportional to each percentage point of average moisture content; others said that it was even more severe. Blowney and Warren [6] proposed a factor of 1.15, while more recently Beldecos and Smith [5] suggested a loss of 1.20 per cent for each per cent of mean moisture content. Soderberg [7] established experimentally that water catchers are effective but moisture losses remain high even after 25 per cent water removal in the low-pressure stages.

Reheating has been used in steam-turbine cycles for at least 40 years, being alternately accepted, abandoned, and accepted again with new high-temperature materials.

In modern fossil-fuel stations the reheater generally is incorporated in the boiler structure. However, moisture control may also be effected by steam-to-steam reheating. It was used by Commonwealth Edison in 1927. With this method, a portion of the steam undergoes less than maximum expansion to improve the aerodynamic performance of the main flow steam in the l-p turbine.

The Cycle

Five of the various cycles for all-nuclear-powered pressurized-water reactor systems studied for the Enrico Fermi station are presented to show their relative effectiveness. The base parameters of steam and feed flow, steam and feed conditions, and turbine-exhaust pressure were the same in all five cycles. Heat input was fixed and the output was determined for each variation of the cycle. In each case it was assumed that a turbine-generator could be provided with the same exhaust losses, dry internal efficiency, mechanical efficiency, and generator efficiency as in the base cycle. In the wet region each stage efficiency was reduced 1.20 per cent for each per cent of mean moisture content.

The theoretical cycle, shown in the *h-s* plane in Fig. 2, and used for comparison, includes a pressurized-water reactor generating saturated steam for a turbine with throttle conditions of 465 psia, at 0.25 per cent moisture. The turbine exhausts at $1^1/_2$ in. Hg abs. This base cycle is impractical, as the terminal moisture of approximately 19 per cent, Fig. 2, would be unreasonable from the standpoints of stage efficiency and erosion.

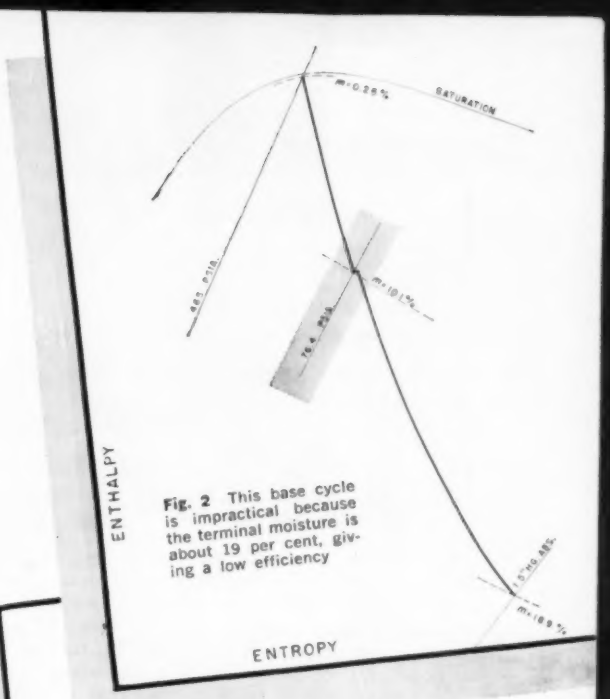

Fig. 2 This base cycle is impractical because the terminal moisture is about 19 per cent, giving a low efficiency

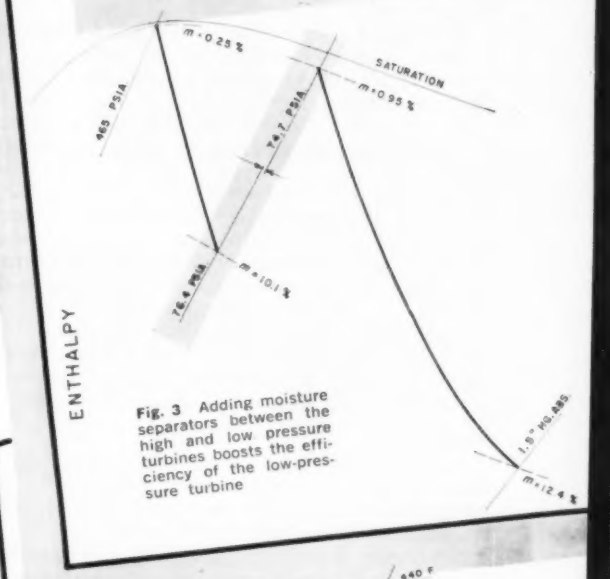

Fig. 3 Adding moisture separators between the high and low pressure turbines boosts the efficiency of the low-pressure turbine

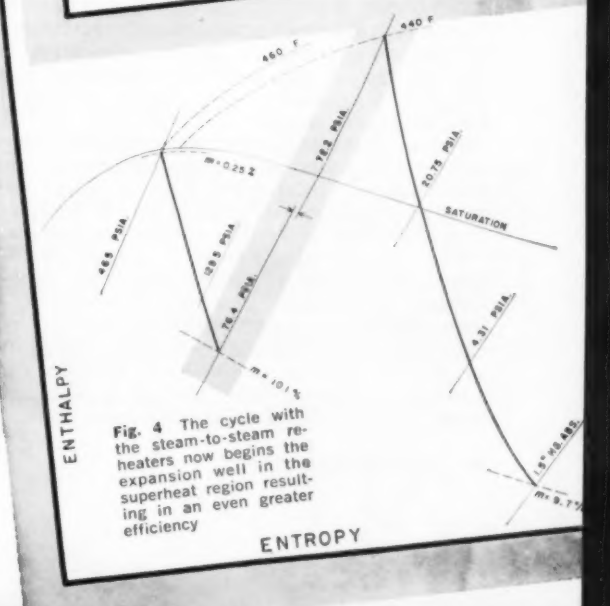

Fig. 4 The cycle with the steam-to-steam reheaters now begins the expansion well in the superheat region resulting in an even greater efficiency

STEAM REHEATER

	CYCLE ARRANGEMENT	Gross Turbine Heat Rate Btu/kwhr	Cycle Eff. %
a	Base cycle (Fig. 2), no separator or reheater	13,384	25.49
b	Separator added (Fig. 3) no reheating	13,275	25.71
c	Separator added; reheat to 440 F (Fig. 4)	12,336	27.66
d	3 feed heaters, separator, no reheat	11,631	29.34
e	4 feed heaters, separator, no reheat	11,551	29.55
f	4 feed heaters, separator, reheat to 430 F	11,296	30.21
g	4 feed heaters, separator, reheat to 440 F	11,270	30.28

Fig. 5 Combined effects of possible combinations

The substantial increase in the efficiency of the l-p turbine achieved by adding moisture separators between the h-p and l-p turbines is illustrated in Fig. 3. Here the moisture separators are assumed to be 90 per cent efficient. The steam now enters the l-p turbine with a quality of 99.5 per cent. The mean moisture content in the l-p turbine is seen to be 6.7 per cent as opposed to 14.5 per cent in the base cycle.

Although a considerable power loss results from the diversion of steam for reheating, the improvement of the performance of the l-p turbine accounts for an almost 2.2 per cent increase in thermal efficiency.

As in conventional steam-turbine cycles, regenerative feedwater heating substantially improves over-all efficiency. In cases d through g of Fig. 5, the combined effects of the several possible combinations are compared. Not only is considerable improvement in heat rate possible by combining moisture separators, steam-to-steam reheaters, and regenerative feedwater heaters, but the improvements are sufficient to justify considerable investment in the additional equipment.

Cycle studies made concurrently by Franco Tosi and the SELNI organization in Italy [8], and by the engineering staff at Gibbs & Hill in New York, resulted in general agreement on the selection of the final cycle, Fig. 4.

The Reheater

Anderson and Chave have also recognized the advantages of the system that will be employed by SELNI, using saturated steam at the turbine throttle for interstage reheating in a nuclear power cycle [9].

New design criteria and balances had to be worked out between manufacturing capability and theoretical requirements. At SELNI the steam-to-steam reheater was the key. It required high performance with close temperature approaches, low pressure drop on the turbine steam side, compactness, and low cost. Turbine-overspeed problems required the volume to be kept low. The required location near the turbine also indicated small over-all dimensions. Such a design has been realized, and the turbine, separators, reheaters, and associated equipment currently are being manufactured.

Engineering studies produced a reheater with the required characteristics. To conform to the double-flow-turbine configuration, two half-size reheaters, Fig. 6, were chosen, one in each of the two cross-under connections between the h-p and l-p elements. Slightly moist steam from the associated moisture separator enters the reheater and flows axially through the shell, emerging superheated. A baffle system distributes the steam uniformly in crossflow to the banks of finned tubes, Fig. 7. The first tube bank constitutes the drain-cooling section of the reheater. The five remaining tube banks are heating sections connected to common supply and drain manifolds. The total surface in the two reheaters is 133,900 sq ft. The tubes are drawn from 70-30 cupro-nickel with an outside diameter of 1 in. and a wall thickness of 16 BWG. A helical groove is plowed along the outside surface of each tube, into which an aluminum spiral is drawn under tension. The tube metal is then mechanically bonded to the base of the aluminum spiral by rolling. The OD of the extended surface is 2 in. The spiral is made from 28-BWG aluminum, wound to a coil spacing of 10 to the inch. The shell is carbon steel, 10 ft 4 in. ID and 19 ft 6 in. long.

The moisture separators, reheaters, and 45-in. cross-under lines are symmetrically arranged, Figs. 8, 9, and 10. However, the inclusion of the reheater causes only a minor increase in the length of the connections and requires only a small amount of additional building space.

Stop valves are located in the 6-in. steam-supply lines to the reheaters. The 45-in. intercept valves, located between the reheater and the l-p turbine, prevent overspeeding of the unit on loss of load. The presence of the reheater has not resulted in any anticipated overspeed-protection problems, and the machine is expected to be equal in this characteristic to any comparable unit without a reheater.

Conclusions

Although about 7 per cent of the throttle steam at the Enrico Fermi Station will be diverted from useful work in the turbines to supply the energy for the reheater, the cycle will have the following advantages:

1 There will be a reduction in cost per net kilowatt generated due to the improvement in turbine cycle efficiency.

2 There will be an increased life expectancy of the turbine as the lower moisture content of the steam in the low-pressure turbine will produce less erosion.

Acknowledgments

The contributions of several engineers at the writers' company should be acknowledged. The concept of using saturated steam for the reheating of steam between turbine sections, in a pressurized-water-reactor cycle, is believed to have been the result of studies made by Lisso Mims (1949–52) and I. G. Stubbart, Mem. ASME (1951–1952).

Thanks are also due to J. B. Prather, Mem. ASME, for the information on the method of optimizing the reheater-drain temperature.

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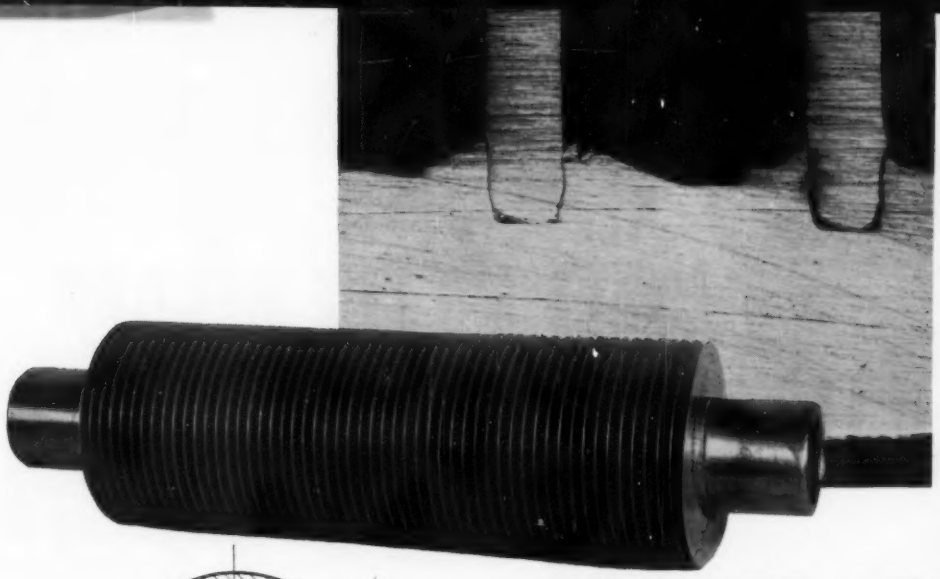
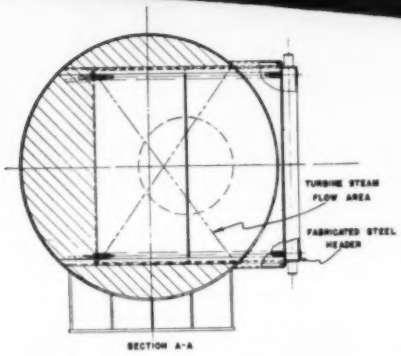
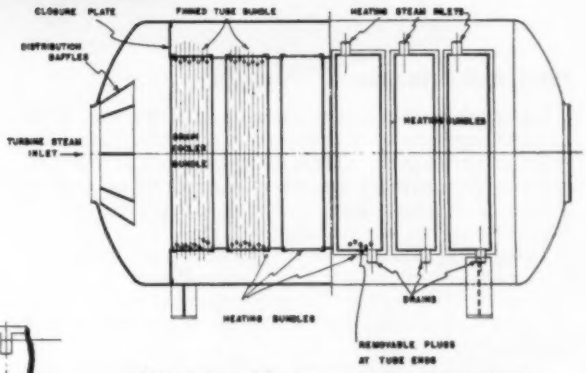
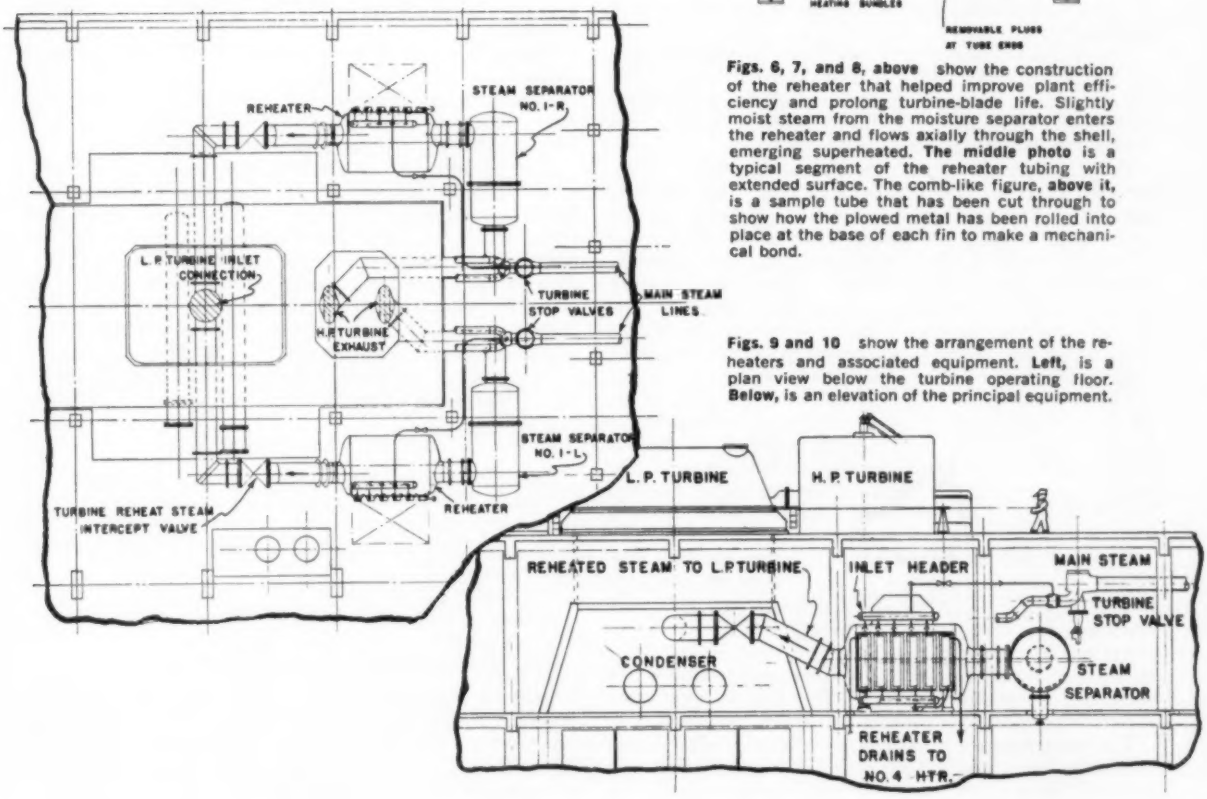






Figs. 6, 7, and 8, above show the construction of the reheater that helped improve plant efficiency and prolong turbine-blade life. Slightly moist steam from the moisture separator enters the reheater and flows axially through the shell, emerging superheated. **The middle photo** is a typical segment of the reheater tubing with extended surface. The comb-like figure, **above it,** is a sample tube that has been cut through to show how the plowed metal has been rolled into place at the base of each fin to make a mechanical bond.

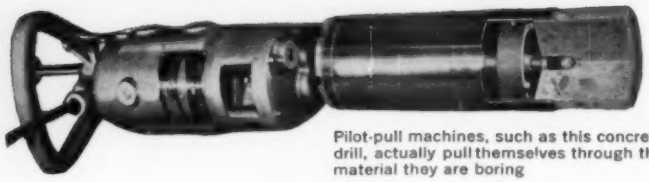


Figs. 9 and 10 show the arrangement of the reheaters and associated equipment. **Left,** is a plan view below the turbine operating floor. **Below,** is an elevation of the principal equipment.

Abstracts and Comments Based on Current Periodicals and Events

ROBERT ARONSON
Editorial Asst.

BRIEFING THE RECORD



Pilot-pull machines, such as this concrete drill, actually pull themselves through the material they are boring

Pilot-Pull Principle

DRILLING methods in the mining industry may be in for a change due to a new boring technique called the pilot-pull principle. This is the name given to a method recently perfected by the Alkirk Corporation, Seattle, Wash. A machine using this idea actually pulls itself into the material it is drilling.

Because the machine pulls against a fixed anchor, it can develop exceptionally great forward thrust at its cutting face. This force enables the machine to bore large diameter holes in the hardest substances at a high rate of penetration.

The two machines already developed by the company are successful applications of the pilot-pull idea. The first, a mining machine, makes use of the product removed from the hole. The other, a concrete drill, has the hole itself as the desired end product.

The diagram illustrates the operating cycle. First, the drill sends a pilot into the material. (On the coal mining machine, the pilot bores its own hole; on the concrete drill it is done with a separate hand tool.) When the pilot is fully extended, its end expands, firmly anchoring the machine. Then the rotating cutter, using the anchored pilot for support, begins to bore into the material's face. When the cutter has moved into the material to the point where the pilot is anchored, the pilot once again moves out.

The key factor in the operation is anchoring the pilot. There are a number of ways to do this, depending on the material being bored. One typical way is to hydraulically expand a rubber collar at the end of the pilot. The collar can develop any pressure needed for anchoring. Design studies have been made for an anchor with a holding capacity greater than one million lb.

The first machine to use this idea, the Alkirk Cycle Miner, has demonstrated its ability in over 300 hr of operation at a mine in Alaska. It delivers coal to a conveyer at a rate of 15 tons per min. The miner has twin pilots and counterrotating drag-bit cutters. It advances on its own tanklike treads, following the double 7-ft bores made by its cutters. The cutters can be positioned to follow horizontal or pitched coal seams.

The other product is a core-type concrete drill. It anchors itself in a small pilot hole, then bores a hole up to 14 in. in diam without external braces, staging, or jacks. The Lawrence Machine and Manufacturing Co., Seattle, Wash., has been licensed by the Alkirk Corporation to manufacture and distribute the drill.

Operation of the drill is similar to mining machine. First, a pilot hole about 1 in. deep is drilled in the concrete using conventional hand tools. The concrete drill is centered on this hole and a pilot extended into it. Then, the end of the pilot expands, anchoring the drill in the concrete. A rotating diamond coring bit is pulled against the concrete by hydraulic force to bore the hole.

The drill works in tight corners, on ceilings, or high walls. The drill may eliminate detailing conduit holes in concerete building walls. Instead of forming the holes when the wall is poured, the contractor can drill the holes economically after the wall is up.

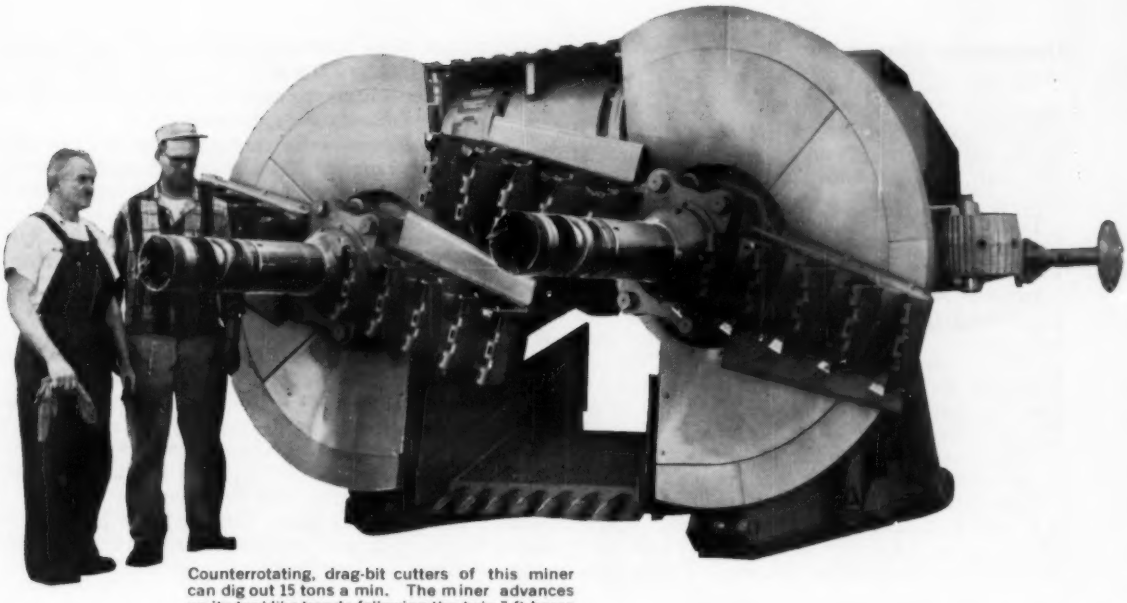
A third device is now under consideration by the company—a hardrock tunneler. Studies indicate a successful machine could be built using rolling cutting tools such as those developed for drilling oil wells. Tunnel drivers have been successful in soft formations, but all machines thus far developed for tunneling hardrock have been generally underpowered and lacked thrust capacity. Tests are now being carried out to determine torque forces needed for hardrock boring.

According to the company, machines using the pilot-pull principle can accomplish almost any hole making function.

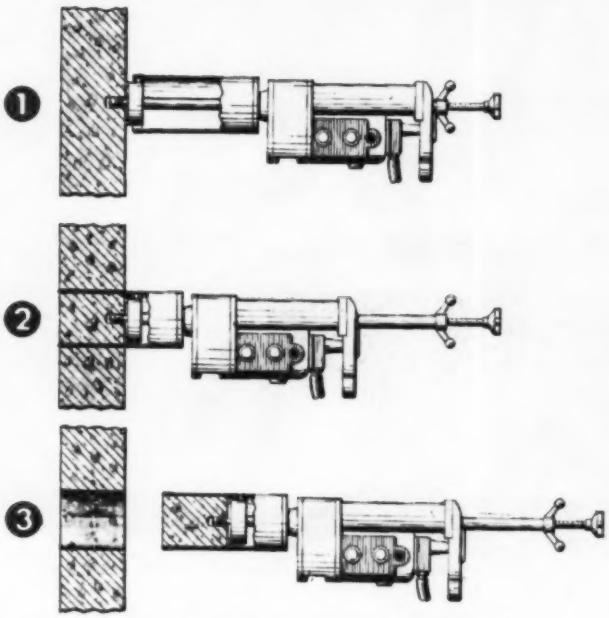
Here are some of the advantages:

Faster in boring large holes in hard substances.
No external bracing needed.
Boring possible at any angle, including vertical.
Holes are true and smooth because there is no machine vibration.
Machine is self-propelled.
Boring is virtually continuous because of the self-advancing pilot.
Feed of cutting tools is precisely controlled.

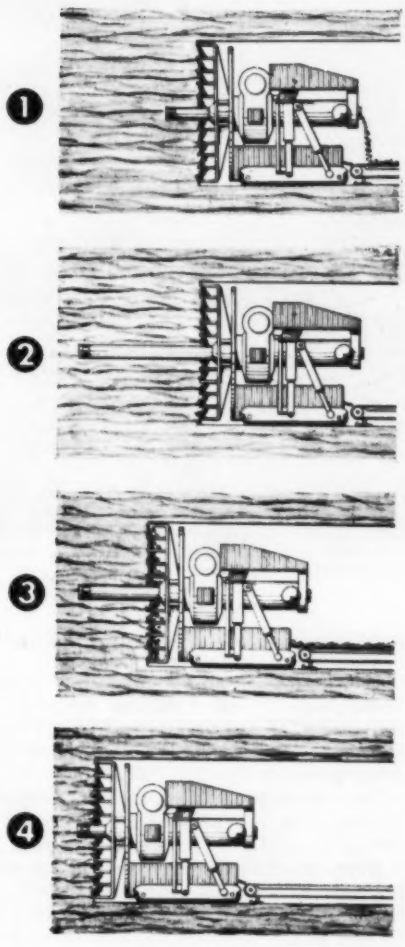
Other applications of the Alkirk pilot-pull principle regarded as feasible today include machines for boring exploratory holes for oil and other minerals, and vertical big-hole drills. There are also potential applications in the machine tool industry.



Counterrotating, drag-bit cutters of this miner can dig out 15 tons a min. The miner advances on its tanklike treads following the twin 7-ft bores



Concrete drill, above, 1 begins its operation by pushing the pilot tube into a 1-in-deep pilot hole. (This pilot hole must be drilled beforehand with hand tools.) Once the pilot tube is seated, the pilot-rod tip is expanded, anchoring the drill. 2 The bit rotates, powered by an electric motor, cutting into the concrete. The bit advances beyond the pilot. 3 When the hole is completed, the core can be removed from the bit by reversing the drill feed. The concrete drill can use core-type diamond bits up to 14 in. in diam.



Miner, right, 1 has just begun to drill its own pilot hole. As the pilot advances, the cuttings pass through the hollow pilot tube and are discharged at the rear of the machine. 2 The fully extended pilot expands the anchor on the end of the pilot tube to firmly secure the machine. 3 The main cutters advance, chewing into the coal seam and spewing the coal out behind. The cutters rely on the anchor to put themselves into the face of the coal seam. 4 With the cycle complete, the pilot tube prepares to advance again. If necessary, the cutting head can change its angle to follow a bending seam.

Underwater Research

THE sea—our long unexplored frontier—is now getting quite a bit of attention. Goaded by military as well as economic and scientific motives, government and industry are co-operating on a number of research projects that will ultimately help exploit the sea's many potentials.

Two such projects announced lately involve the construction of two submarines designed specially for undersea research.

Aluminum Submarine. A quartet of scientific, military, and industrial organizations will co-operate to build and operate the *Aluminaut*, our first aluminum submarine. General Dynamics will build the boat for Reynolds Metals Company. Reynolds will, in turn, lease the boat to Woods Hole Oceanographic Institution. The U. S. Navy is sponsoring the project.

The *Aluminaut* will be able to take a crew of three (two scientists and a pilot) to a depth of over 15,000 ft.

From this craft the Navy hopes to find out if aluminum is a suitable material for submarine hulls. Experiments carried out in the depths of the sea may also yield valuable data for antisubmarine warfare. Exploration of the sea's bottom may also turn up possible mineral and food sources.

Eleven forged aluminum cylinders with aluminum hemispheres at either end make up the sub's pressure hull. The alloy used in the hull (7079-T6) has a yield strength of 60,000 psi. The hull should be able to withstand pressures up to 10,000 psi.

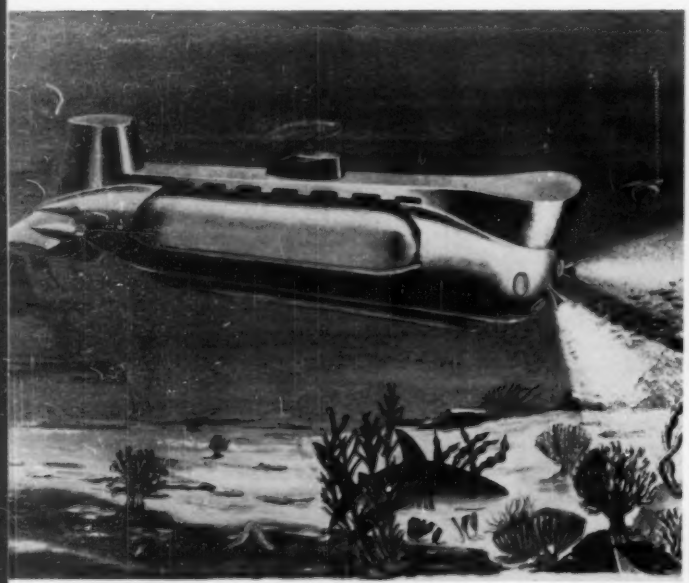
Two main propulsion units will send the *Aluminaut* through the sea at a maximum speed of 3.8 knots. Cruising speed will be about 2 knots. Each unit will deliver a maximum of five horsepower, driving twin propellers. In addition, the vehicle will have a vertical propulsion motor and propeller. Power for propulsion, as well as the scientific equipment, will come from four 77-cell silver zinc storage batteries. Other equipment includes underwater television, underwater lights, and a prosthetic arm (mechanical manipulator) to retrieve samples from the ocean bottom.

The *Aluminaut* can stay down up to 72 hr and travel within a range of 80 miles. With its deep diving capability, it will have access to 60 per cent of the world's ocean bottoms.

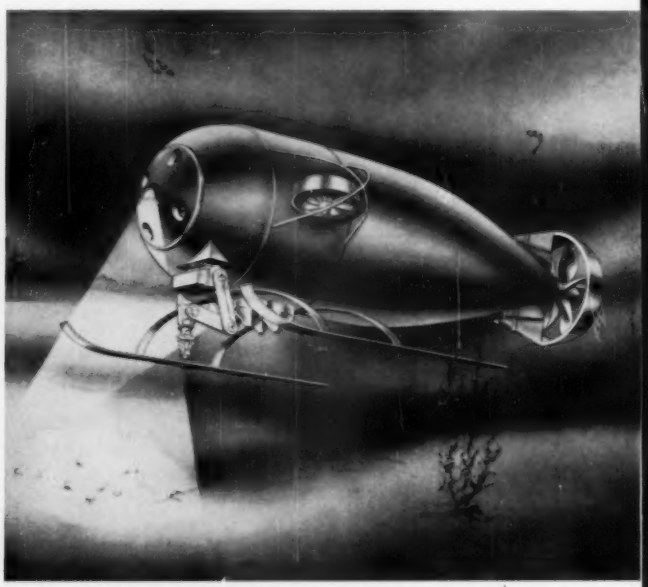
During a trip, the *Aluminaut* will first reach a predetermined depth. There, it becomes neutrally buoyant through the use of a carefully determined amount of shot ballast loaded aboard prior to the dive. To reach lesser depths, they will drop more shot. For additional maneuverability there is a vertical propeller for moving above or below the neutral depth.

Projects for the craft will include prolonged measurements of temperature, pressure, and salinity of a water column, and investigation of the deep scattering sound layer through the correlation of acoustics measurements, visual observation, and photography.

Research—600 Ft Down. General Mills' Electronics Group has an underseas research vehicle—the *Seapup VI*. It is designed for operation to depths of 6000 ft.



This aluminum-hull submarine will carry its three-man crew to depths of 15,000 ft for experiments and exploration



"Seapup VI," a two-man undersea research vehicle, can use its mechanical arm to take specimens from the ocean floor

The *Seapup VI* will hover and rotate, and can maneuver precisely. The vessel has a low weight-in-air and compact size. With all equipment it weighs only 12,600 lb. Length is about 18.5 ft and over-all width is 8 ft. There is a specially adapted mechanical arm, identical to that developed by General Mills for installation on the bathyscaph, *Trieste*, so the *Seapup VI* can perform manual tasks while hovering at great depths or resting on the ocean floor.

Underwater, it will be moved by a 34-in. shrouded propeller on the stern. To maneuver, there are two 14-in. shrouded propellers that extend from the vessel's side. D-c motors powered by a silver zinc oxide battery turn the propellers. Operational speed is 2 to 4 knots.

Two Companies Make Supermagnets

RCA AND WESTINGHOUSE have found the key to producing high-strength magnets from superconducting material. Working independently, they have solved the manufacturing problems that for so long kept the amazing properties of the superconductors only a laboratory curiosity. These magnets will probably bring about significant improvements in power generation and make long-distance space travel more feasible.

Doughnut-Size Magnet. Westinghouse has been working to produce a supermagnet from niobium-zirconium base alloys. Superconducting materials—niobium-zirconium base alloy is one of them—have the remarkable property of losing all electrical resistance at temperatures near absolute zero. Once started, supercurrents of electricity flow through superconductors forever without loss in strength.

One of the new superconducting magnets, the size of a doughnut and weighing only 1 lb, can create a magnet field twice as strong as that produced by a conventional iron-core electromagnet as large as an automobile and weighing 40,000 lb. Such a conventional magnet would need 100,000 watts to run. In contrast, the new supermagnet runs from an ordinary automobile storage battery. The only power the battery continuously supplies is a few watts to overcome the small losses in the wires leading to the magnet. The superconducting magnet produces a magnetic strength or flux density of 43,000 gauss (43,000 lines per sq cm).

The magnet is made of about 5000 turns of threadlike wire made from niobium-zirconium base alloy. It is wound into coil, or solenoid, 2 in. in diam, $1^1/_2$ half in. long, and with $^1/_2$-in-diam hole.

The coil is immersed in a vessel of liquid helium that keeps it at a temperature near −450 F. The energy needed to cool the coil is only a small fraction of that needed to create a comparable magnetic field with a standard electromagnet. Essentially, the magnet produces almost all of its supermagnetism "for free."

Since most superconductors are hard to handle and are sometimes as brittle as glass, they all require the most careful processing if their superconducting properties are to be preserved. The wire itself is about three times the thickness of a human hair but carries a current of 20 amp.

Magnets Need No Power Crystalline niobium-tin, a superconductive compound, has the property of generating and sustaining a very strong magnetic field without an external power supply. Until now, no satisfactory method had been devised to produce this material in the desired crystal form in quantities necessary for widespread use. This is due largely to the extreme brittleness of the crystalline substance and the consequent difficulty of working with it.

Scientists of the Radio Corporation of America have recently come up with a process that can mass produce this material. It is a simple chemical process for rapid and continuous growth of crystalline niobium-tin. In a laboratory apparatus, wire can be coated with niobium-tin at the rate of 30 ft per hr. Production refinements will probably increase this rate.

The importance of the niobium-tin compound lies in its unusual properties as a superconductor—this type of material loses its electrical resistance at extremely low temperatures, close to absolute zero, so that it will continue to carry indefinitely a flow of current that is started by a small initial pulse. This superconductive property disappears in all previously known materials with a relatively small increase of temperature or in the presence of a strong magnetic field.

Niobium-tin, however, has been found to remain superconductive at somewhat higher temperature than do any other known superconductors, and in far stronger magnetic fields. For this reason, it has been regarded as a possible source of extremely high magnetic fields that can be sustained without consuming very large amounts of power. Only a small initial voltage is needed to start a current flowing.

The finished wire has performed successfully in tests involving as many as ninety turns of wire around a three-quarters in. diam coil form. In addition, tests on short-wire lengths performed at the Lawrence Radiation Laboratory, University of California, Berkeley, indicate that the wire remains superconductive in 94,000 gauss magnetic fields, while supporting a current of 7 amperes. This represents a current density in the superconductive coating of 100,000 amperes per square centimeter. These tests demonstrate the feasibility of winding the wire in any desired lengths to form extremely powerful magnets without the danger of its cracking or otherwise losing its useful properties.

The new manufacturing technique can be used to produce niobium-tin wire in lengths of thousands of feet for use in a new family of light, economical, and extremely powerful magnets. For example, it is expected that a niobium-tin wire-wound magnet weighing only about 20 pounds (exclusive of its accompanying refrigeration equipment) and started with a pulse from a 6-volt battery, will produce a magnetic field over a volume that now requires a 100-ton electromagnet operated continuously by a 100-kilowatt power supply.

Such a development will lower the bulk, cost, and complexity of large nuclear research machines such as cyclotrons and stellarators, where multiton magnets and large power generators are now needed to produce the strong magnetic fields.

Once started, supercurrents of electricity flow through these magnets forever, creating strong magnetic fields

Drawing boards are missing in this engineering room. Engineer **at left** is discussing proposed design. **At right,** two more engineers check specifications against the designs on the rear board. Engineer at camera is preparing to photograph a blackboard design for a permanent record.

Blackboard Replaces Drawing Board

A NEW system called Panoramic Design Technique does away with drawings made on the usual drawing boards. Instead, engineers put their ideas directly on wall-size blackboards. For permanent record the blackboard sketches are photographed.

The new method is said to cut from 33 to 50 per cent from drafting, design, and engineering costs at TAB Engineering, Inc., developers of the program. For example, on a packaging machine for a food processor, TAB estimated a building time of six months and a cost of $80,000. But, using the Panoramic Design Technique, they delivered the machine in 90 days at a cost of $48,000.

In conventional engineering practice a designer makes drawings of his ideas on his drawing board, and then submits them for approval or revision. As many as 10 or 20 engineers and designers might work on parts of a design at the same time and a chief engineer must look at their work individually. With the basic design developed, the work goes to detailers who spend hours preparing the drawings to make a model.

In the new program, the fabrication of a better engineered machine can start much faster to give the client the benefits of the new equipment sooner. With the TAB method, the engineers and designers work together as a group at a huge blackboard. Each man is assigned a specific part of the design to develop, and his ideas are constantly on display as he progresses. The director of engineering or project manager can see the project in its entirety instead of inspecting individual drawings one at a time. If a change is indicated, it can be made just by erasing the chalk and sketching a new version.

There is also a change in the engineer's efficiency. By seeing how his portion of the design fits the whole pattern, he is stimulated to work better himself. And, he can frequently help his fellow engineers on the board by suggesting improvements for their phase of the project.

While the technique sounds simple, in practice it takes considerable skill to conduct properly. Getting the engineers and designers to accept the new method and acquire the proper new habits is said to be one of the biggest challenges.

The blackboard technique has one important advantage that some engineers and designers may not want to acknowledge—it forces them to work. It's hard to tell if a man at a drawing board or desk is studying a design, sleeping, or daydreaming. He may puzzle over an idea for days before lifting a pencil. But, he can't be idle at the blackboard. If he stands still, others will notice and pitch in to help him. This is one of the big cost-saving advantages of the technique.

By sketching the basic design on the blackboard full size or larger—sometimes difficult or impossible on drawing paper—the engineer can visualize the design more easily. He can also see how its component parts fit together. This in turn speeds the process of creative design.

When a satisfactory design is developed, a detailed drawing can be made immediately by the use of a ruled plastic overlay. The engineer can sketch on the other views and add dimensions. Instead of transferring this work to a paper drawing, they take photographs of the design.

When the process was first used they planned to make blueprint size enlargements of the photographic print. But they found that people in the shop could read the dimensions right off the pocket-size print. Actually, they preferred the small prints, since they no longer had to find space to unroll a stack of large drawings, and they could carry the complete assembly and detail drawings in a shirt pocket. Similarly, the engineer and foreman could conveniently use these pocket-size prints for reference. Bulky rolls of drawings were eliminated along with the practice of running back and forth between the job and the office where the prints were laid out.

The requirements for the Panoramic Design Technique are wall-size blackboards, drawing instruments made for blackboard use, photographic equipment, and the patience and skill to make the change from conventional engineering and design methods.

Back-Pack Generator

THE new products laboratories of Westinghouse Electric Corporation have delivered to the Bureau of Ships, U. S. Navy, a portable back-pack thermoelectric generator. The generator is an experimental electric plant that can produce useful amounts of power, yet is light enough to be carried by one man.

Thermoelectric generators produce electricity by converting it directly from a source of heat. The Navy-Westinghouse generator burns bottled propane gas and can be adapted to burn ordinary gasoline.

Solid, semiconductor-type materials change the heat of the gas flame into electricity when a difference in temperature is maintained across them. A small fan, taking its power from the generator, blows air across the cool side of the materials.

The new generator develops a gross of 340 watts of electric power; 80 watts are used to drive the fan. Average operating temperature is 842 F on its hot side, and 284 F on the cool side.

Without its gas tank and mounting frame, the portable power plant weighs 36 lb. Its 450 thermoelectric couples are mounted hexagonally around the gas burner, giving a structure 11 in. in diam and 22 in. long.

The generator is now undergoing laboratory testing at the U. S. Naval Engineering and Experimental Station, Annapolis, Md.

Atomics International recently announced it also has a flame-heated thermionic generator in operation. This unit burns a mixture of propane and air.

MemoTutor, a teaching aid, can help school children memorize multiplication tables, or a machinist memorize specifications. The device can be applied to any memorization chore involving associated pairs.

Teaching Machine

MEMORIZING is said to be quicker and easier through the use of a new machine called the MemoTutor. The device follows the scientific principles for memorizing that have been established by educational psychologists. The manufacturer, U. S. Industries, Inc., says anyone can memorize factual information efficiently with the help of a MemoTutor.

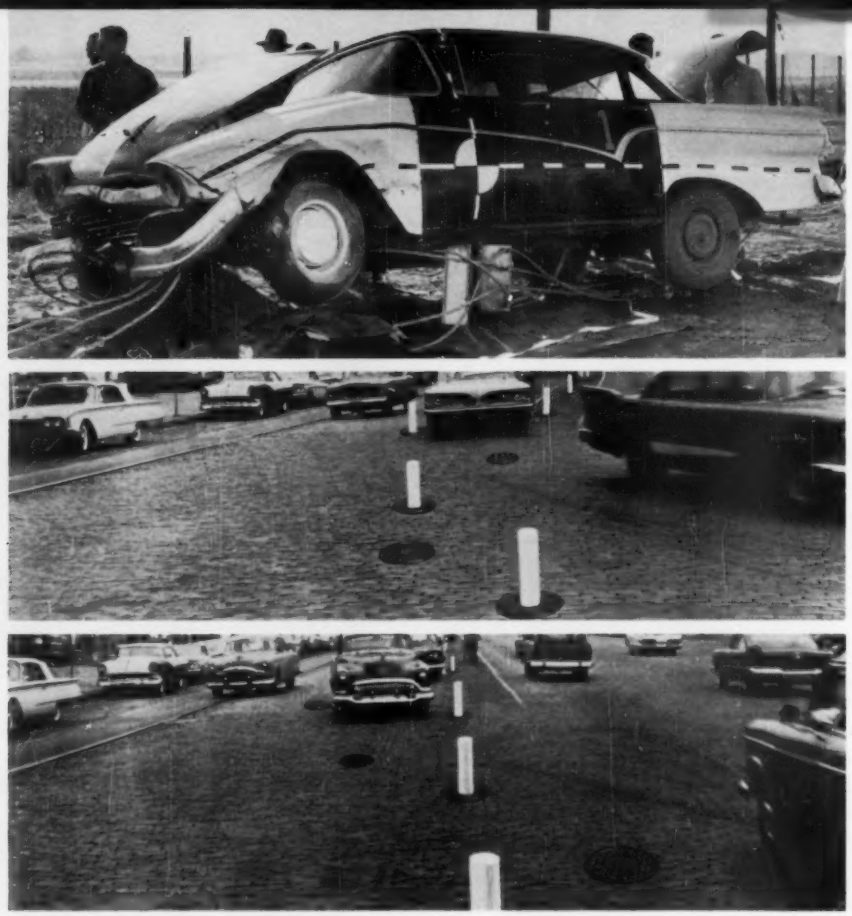
Information is presented visually in the form of "associated pairs"—such as dates, figures, sums, words, and symbols. The list of memory information is endless. By teaching the student to associate one item with another (an English word with its equivalent in another language, for example) the human memory is well drilled and the answers become unconscious and automatic.

The MemoTutor is useful wherever you want to make learning easier and more efficient by freeing the live teacher of routine class work and review. The machine's job is to supplement the teacher and enable him to concentrate on the creative and stimulating part of the curriculum.

The machine is designed so that a person trying to memorize a given set of facts can indicate the items he feels uncertain about. The MemoTutor then gives special emphasis to those items as it drills him. The MemoTutor also eliminates wasted time by automatically dropping items that turn out to be quickly and easily memorized by an individual.

The learning content of the MemoTutor can be changed by substituting one sheet of paper for another. The information to be learned is easily inserted into the machine.

A number of basic sets of information ranging from multiplication tables to the Morse Code will be available from U. S. Industries, Inc., but the individual in charge of programming for a MemoTutor will be encouraged, in most cases, to transcribe his own information fitting the material to be memorized. This is a simple matter on MemoTutor paper, which is ruled for typewriter spacing.



Here are two approaches to accident prevention. **Top,** cars are wrecked "scientifically" to test the design of roadside barriers. **Bottom,** plastic rods pop up from the road to control traffic patterns.

Automotive Safety

With the increasing toll of dead and injured from automotive accidents, safety on the highway is becoming of greater concern to the engineer. Many organizations are working on devices or systems that try to prevent accidents, or make their consequences less serious. The following are three examples.

Scheduled Accidents. In the interest of highway safety, cars are being cracked up to determine how future highway guide rails and similar barriers should be designed. The research program, which has demolished four cars in as many tests, is sponsored by the New York State Department of Public Works with financial assistance from the Federal Bureau of Public Roads. Tests take place at the Cornell Aeronautical Laboratory.

One of the main purposes of the program is to get a detailed understanding of barriers subjected to vehicle impact and apply that knowledge to future barrier design. Until now, the familiar fences lining our highways have been designed from experience, not scientific knowledge.

The basic research problem is to predict the level of protection offered by a given highway barrier system under crash conditions. In the research approach adopted by CAL, engineers have crashed obsolete State Police cars into various types of barriers to collect experimental data for verifying the analytical phase of the program.

A network of electronic and photographic equipment records the findings. Engineers traveling in a "chase car" operate the crash vehicle by radio control. They send the crash car into the barrier at a predetermined speed and angle.

Although the test is over in seconds, preparation for the test can take weeks. When the test is finally conducted, the car must hit a precise spot on the barrier if findings are to be recorded accurately.

Preliminary reports show that the type of barrier, the angle of impact, and the speed of impact all combine to vary the hazards in a given instance.

The problem is not simply to devise a means of preventing vehicles from leaving the highway. The barrier should hold or deflect the vehicle back onto the roadway with minimum obstruction, to traffic, and with minimum injury to the occupants.

The barrier of the future will redirect the vehicle along a path parallel to the barrier. The vehicle can then stop gradually instead of suddenly—as is often the case today.

Asleep at the Wheel. The Alert-O-Matic is a device that gives a solution to the serious accident problem of going to sleep at the wheel. It was perfected by safety engineers of the Liberty Mutual Insurance Company's Research Center, Hopkinton, Mass.

To keep sleepy drivers alert, it produces a series of three signals of increasing intensity and severity in progressive stages. A mechanic can wire the device to the electrical circuit of any truck or pleasure car.

Here is the operating sequence:

1 Check the alertness of the driver by blinking a light at predetermined intervals. If the driver notices the light he turns it off by tapping lightly on the horn ring which is wired into the Alert-O-Matic circuit. There is a delay in the circuit to allow for the driver being preoccupied with some driving problem such as passing.

2 If the driver ignores the light for five seconds, the car's horn blows. This usually rouses the dozing driver. The blowing horn also serves as a warning signal to others that something is wrong with the driver.

3 After three seconds of horn blowing, the Alert-O-Matic sets off a third signal. The vehicle's ignition automatically turns on and off in rapid succession, giving the vehicle a series of severe jolts. After five seconds of jolting, if there is still no driver response, the ignition turns off and the car comes to a slow stop.

A driver will usually react promptly to the first light-signal stimulus. If he does, the second and third steps need not take place. Depressing and releasing the horn ring at any moment during these three events stops the cycle. The light turns off, the horn stops blowing, or the car's engine starts.

Cycles are reactivated at 60-sec intervals. They can, however, be lengthened or shortened depending on conditions and safety requirements.

Pop-up Traffic Markers. A new internally illuminated traffic marker makes possible automatic changes in traffic patterns. The markers are in individual housings that are buried in the street. They rise above the street surface or return to street level as required to change traffic patterns. The system is electrically powered.

The Movatron markers, as the system is called, are made of General Electric silicone rubber and come either nonilluminated or internally illuminated. Tests show the markers remain undamaged by tire impact up to 60 mph. The material snaps back into position when bent double, even at subzero temperatures. A heater in each unit prevents winter freezing.

Some suggested uses for the Movatron marker:

As highway check point and tollgate barriers.

Automatic emergency barricades that permit emergency vehicles to cross roads without damage to vehicle or barrier.

Movatron operates with automatic time-clock control that operates as many as 50 units at definite hours; manual push button control; or control by radar or radio.

Helium Conservation

The Department of the Interior has announced plans to conserve 52 billion cu ft of helium that otherwise would be wasted. Helium is now lost at the rate of four million cu ft per year through burning helium-bearing natural gas as fuel. The first contract for a helium extraction plant has already been awarded. It calls for a plant capable of producing raw helium at a rate of 700 million cu ft per year.

Helium produced under the new program will be recovered by private industry, in plants built with private funds, then sold to the Government for storage until needed. Since helium does not deteriorate, the program will insure a readily available reserve for generations to come. To finance the long-range program, the Department of the Interior plans to increase the wholesale price of helium from $19 to $35 per thousand cu ft.

Whirlibirds

Helicopters are becoming more and more important to business and industry, and the variety of services they perform is continually being increased. The first practical helicopter to be designed and built in the Western Hemisphere was completed in 1939; today, the operations of helicopters in the North American continent amount to $55 million per year, not including the services at Los Angeles, New York, and Chicago airports. More than 100 U. S. companies own and operate their own helicopters; most helicopter operations, however, are conducted by firms specializing in contract, lease, or charter work.

According to an article which appeared in the September, 1961, issue of the Industrial Bulletin of Arthur D. Little, Incorporated, helicopters are used mostly for short-haul transportation and for exploration. One operator has contracts with more than 55 companies, primarily for executive transportation, package delivery of parts, transportation line surveys, road building surveys, and aerial photography. The same company has established a number of heliports spotted all over the city of Chicago.

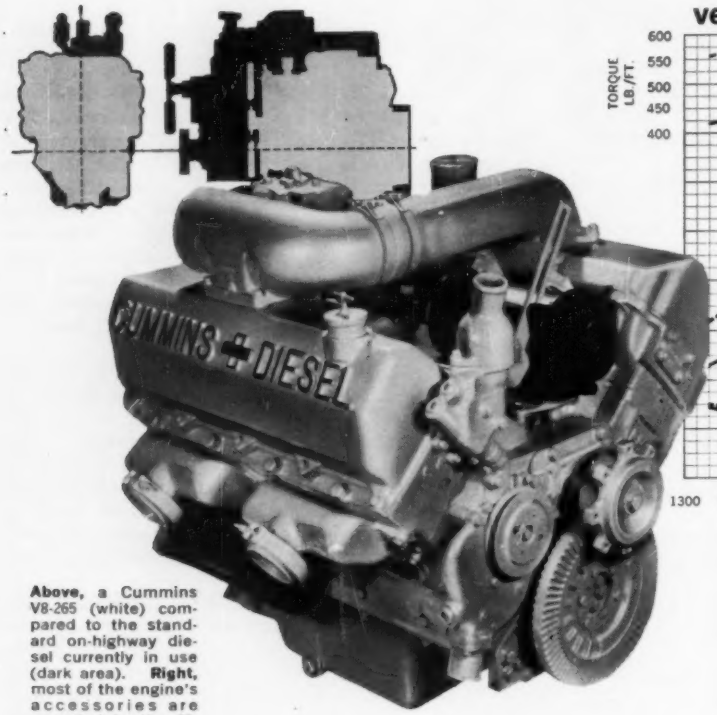
The government has let many contracts for short-haul transportation of heavy loads by helicopter; for the short run, the greater the cargo, the greater the profit. One company has developed a model that has a carrying capacity of three tons for a 100-mile range, and up to five tons for shorter hauls. It cruises at 150–155 miles per hour and floats on water with the rear ramp open.

This same craft can be converted for passenger use—it seats 25 passengers, two pilots, and one hostess, and carries 1500 pounds of baggage. The machine has tandem gas-turbine engines with rotors that are 50 ft in diam. Using twin engines is controversial in the industry; some feel they contribute to safety, while others feel that the number of rotors is determined entirely by the job to be done.

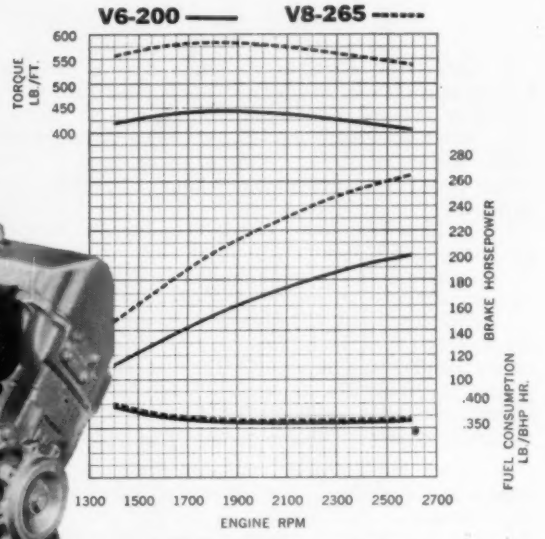
Helicopters have been used in forest fire fighting and patrol, for spraying insecticides on crops and trees, for power line inspection and construction, and even installing utility wire. The Puerto Rico Water Resources Authority found that the cost for installing electrical transmission lines by conventional means ran $120 to $380 per pole, whereas by helicopter, the cost for the same installation ran only $35 to $75 per pole.

Recent Developments. Among recent developments are a new helicopter speed record of 192 miles per hour and an altitude record of about 19,000 feet, established by a four-bladed helicopter in the Himalayas. New equipment includes the twin-turbine antisubmarine hunter-killer, and the first American turbine-powered helicopter certified for commercial operation. Another turbine-powered craft, now being designed, will be able to carry up to 40 tons. Still another new ship is used as a means for handling unwieldy and very heavy cargoes; the load is carried externally, and picked up and delivered by means of hoists and winches.

Safety is an important factor in the use of helicopters. According to statistics based on the passenger services at Los Angeles, New York, and Chicago airports over the past ten years, the accident rate of fixed wing aircraft was 1.6 accidents per 100,000 departures and of helicopters, 1.4. And as further proof of the safety of helicopter travel, the President of the United States is allowed to fly in single-engine helicopters, but not in single-engine fixed wing aircraft.



Above, a Cummins V8-265 (white) compared to the standard on-highway diesel currently in use (dark area). **Right,** most of the engine's accessories are mounted in the 90-deg V.



Horsepower, torque, and fuel consumption curves show performance corrected to standard conditions of 29.92 in. of mercury barometric pressure (sea level) and 60 deg F intake air temperature. These curves represent performance of engines with fuel systems, water pump, lubricating oil pump, and air cleaner. Battery charging generator, compressor, fan, and optional equipment are not included in these ratings.

Compact Diesels

Two new compact diesels, recently put out by Cummins Engine Company, will give truckers all of the advantages the diesel offers but without the penalty of extra bulk and weight. The V-265 (V-8 configuration, 265 hp) and the V-200 (V-6, 200 hp) give up to one-half ton reduction in truck weight. Since the engines are lighter, they result in more miles per gallon and allow up to 10 per cent more payload. Weight is extremely significant to over-the-road truckers, who are limited by state truck weight and length laws.

Both the V-6 and V-8 are rated at 2600 rpm, yet piston speeds are lower than any other four-stroke diesel. An additional benefit of the high rpm is that lighter transmission can be used with the V-6 because of the high rotating speed.

Fuel economy for both engines is equal or better than most Cummins economy diesels and reported to be superior to competitive diesels.

Engine Design. The blocks of the engines are cast iron, the same as used in the production of all Cummins diesels. Some parts are aluminum but none is used in high-stress areas.

The successful NH Series Cummins diesel was the design standard for the V6-200 and V8-265. All fuel and lubricating lines are passages drilled in the block, eliminating external tubing. All accessories are located in the 90-deg V between the cylinder banks for accessibility and compactness.

Food Preservation by Radiation

In its new research program, the U. S. Atomic Energy Commission is trying to use low dose radiation to preserve perishable foods. Relatively low doses of radiation will inhibit the growth of microbes for days or weeks. Low dose preservation, known also as radiation pasteurization, would avoid freezing perishable foods that are to be sold within a short time. The experiments will also consider control of sprouts, disinfestation of grain, and control of insects for quarantine purposes.

The Army Quartermaster Corps is working on a similar program investigating sterilization of food by radiation. The object is to develop sterilized food, capable of reasonable shelf life at room temperatures.

In the Army program, foods are irradiated with high doses of radiation capable of completely destroying bacteria and permitting food preservation without refrigeration for months. Through the program they hope to improve the logistics and acceptability of military rations. Ultimately it may have civilian applications.

A limited number of foods was selected for emphasis, as the successful development of even one or two items will encourage industry to develop a spectrum of food processes. Since mild irradiation extends the shelf life of foods for short periods, it is most suitable for perishable products. Development emphasis is thus placed on two classes of foods: Fish—specifically clams, haddock, shrimp, crab, and flounder. Fruit—including strawberries, grapes, citrus products, tomatoes, and peaches.

Low dose radiation does not cause the sometimes unacceptable changes in flavor, odor, and other organoleptic factors that present difficult problems in the high dose sterilization program. Although the effects of radiation at low dose are known to be minimal, further detailed investigation on biochemical factors are necessary to insure the safety and acceptability of the process.

Many commercial and economic problems concerning the new food processing technique are also being investigated. These include the proper time of irradiation with respect to harvesting, packaging the irradiated

foods, the effects on maintained freshness during shipment of the food to market, and changes in distribution and marketing methods made possible by the radiation processing.

Those carrying out the experiments believe the radiation process will make an important contribution to the world food economy. Also, industry will probably increase its participation once the economic potential becomes clear.

There are signs of growing confidence in the process elsewhere. For example, Canada approved the consumption of sprout-inhibited potatoes this past June. The Russians have already granted such approval.

Sweden's Underground Power Plants[1]

In 1910 the first underground hydroelectric station of any size was completed in Sweden with a capacity of 12 mw. Since then a great number of underground power stations have been built. There are now about 30 plants of this kind, with a total capacity of 3650 mw. This means that 53 per cent of Sweden's hydroelectric power is produced in underground stations.

There are 17 more underground hydroelectric stations —with a capacity of more than 10 mw each—now under construction or scheduled to be completed before 1966. Their total capacity amounts to 1600 mw.

An underground steam power station with a final capacity of 800 mw is also under construction by the Swedish State Power Board. One 150-mw unit was put into operation in 1959 and a second unit in 1960.

Presumably, several of the future nuclear power plants in Sweden will be built underground. A small underground research nuclear plant has been in operation for several years. The first commercial nuclear plant with a thermal capacity for district heating of 55 mw, combined with an electric capacity of 10 mw, is also located underground and is scheduled to be completed in 1963.

Why are so many of the power plants built underground? There are two reasons—national defense and economy. For the most part, purely economic considerations lead to underground construction. The concomitant advantage of effective protection of the plant in case of war is also considered to be of great value. As to the afore-mentioned steam power plant, it is constructed underground for defense purposes. A nuclear plant may be constructed underground for safety as well as for defense.

The fact that underground hydroelectric plants turn out to be most economical depends very much on the nature of the watercourse. One condition is a good quality of rock.

The most important point in the matter of costs is the possibility of concentrating the head to obtain large plants. The general tendency is such that the specific cost of the power station decreases with increasing head.

In the matter of economic comparisons between various alternatives, it should be noted that the maintenance cost of tunnels and other excavated rock rooms is lower than for corresponding structures in a plant above ground for which concrete must be used to a great extent. The rate of depreciation will also be different and in favor of the underground plant.

Underground construction is a more complicated field of construction technique than surface rock and earth excavation. Therefore there remains much more to be done in the field of underground construction than in the other fields. It is probable that underground power plants will tend to be more economical in the future than now, as compared to surface designs.

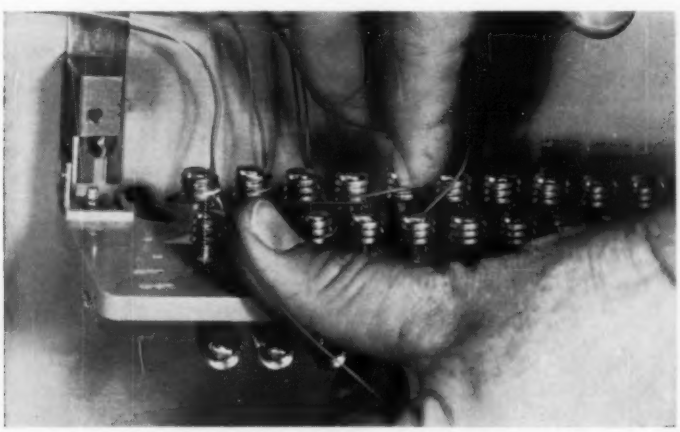
[1] Condensed from the booklet, "Underground Power Plants in Sweden," by Tore Nilsson, and published by the Swedish State Power Board, Stockholm, Sweden.

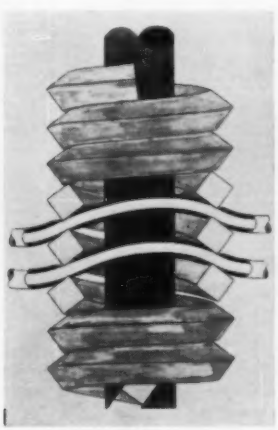
Terminal Connector Replaces Binding Posts

With this new coil spring connector, wires can be connected rapidly and without first stripping the insulation. Also, they can be connected and disconnected without disturbing other wires connected to the same post. (When a binding post and nut are used, all the wires on the post must often be disconnected and then reconnected to service one wire.)

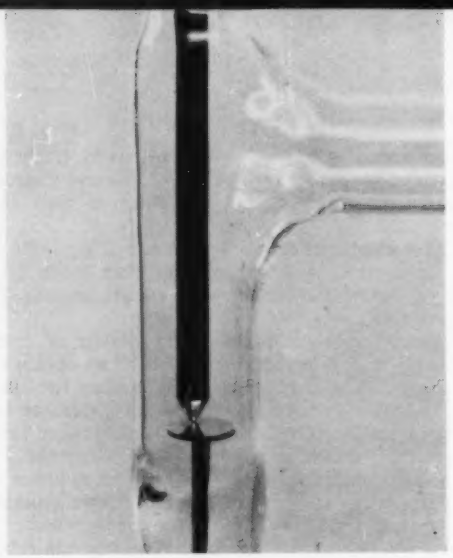
The new connector, which looks like a coil spring, has been developed by Bell Telephone Laboratories. It is expected to replace the standard binding post and nut arrangement for connecting wires to terminals.

The wire of the spring coil is square instead of round. When insulated wire is looped around the spring once and pulled tight, the wire is forced between two turns of the coil. The sharp square edges of the connector bite through the plastic insulation and make multiple contacts with the wire. The contacts are both electrically stable and vibration proof.





Wire is looped around a coil spring connector and pulled tight. When the wire is forced between the turns, the coil's sharp edges cut through the insulation and make stable, vibration-proof contacts with the wire.



A cold-rolled steel rod and base in the glass vacuum chamber test the seizure of metals in ultrahigh vacuum

The Dangerous Vacuum of Space

WHAT will happen to conventional materials in the cold vacuum of space? In this new environment, how will they respond? The answers to these questions must be known before men or equipment are sent into space.

In experiments now being carried on at the Hughes Aircraft Company, scientists are simulating the conditions of space in a small vacuum chamber. In one such experiment a piece of metal is placed in the chamber and the pressure reduced to 10^{-12} atm. The result—the metal begins to evaporate. This example shows how a whole space vehicle might disappear during an extended space voyage if the wrong metal is used.

Some of the specific problems being studied are:

- Grease and other lubricants vaporize in ultrahigh vacuum, and a machine that runs smoothly on earth would halt in space as its bearings dry up and seize.
- Cold welding of metals in contact with each other becomes a fact in a matter of days in absence of air. The phenomenon, due to molecular attraction, occurs after evaporation of layers of adsorbed gases and impurities which coat all materials in atmosphere. Bare atom can then contact bare atom and metals attach to each other as securely as a welded joint.
- Some tough plastics, such as vinyl, grow brittle and lose strength due to evaporation of their plasticizer. In other cases, high vacuum "protects" plastics. Teflon, for example, crumbles to powder when exposed to radiation in the earth's atmosphere, and was thought to be unsuitable for use in space. At Hughes, irradiation was performed in ultrahigh vacuum to simulate a realistic space environment, and it was found that teflon retains its strength and is, in fact, an excellent material to use in space.
- Microorganisms die if exposed to ultrahigh vacuum for periods of 20 to 30 days, indicating that the costly practice of sterilizing the exterior of spacecraft prior to launch to avoid contaminating other planets may not be necessary. These findings also argue against the theory that life may have been brought to earth in the form of free-floating spores from outer space.

These problems, though difficult, are not insoluble. For example, on the problem with metal evaporation, tests show that certain coatings can reduce evaporation rates by as much as 70 times. Gold plating also was effective.

The metals most susceptible to evaporation were cadmium, zinc, and certain magnesium alloys. However, iron and steel were highly resistant and would last for years in space. Titanium, tungsten, and platinum are among the best materials.

Work must continue on these and other problems because in the environment of space even the most commonplace practices must be carefully tested.

Molecular Slide Rule

THE Westinghouse research laboratories have demonstrated an electronic device described as a "molecular slide rule." The tiny device electronically performs multiplication and division by a process similar to that used in the familiar mechanical slide rule. Yet, the new multiplier-divider has no conventional electronic components or circuitry. It is simply a solid slice of silicon about the size of the head of a thumbtack and as thick as a few sheets of paper.

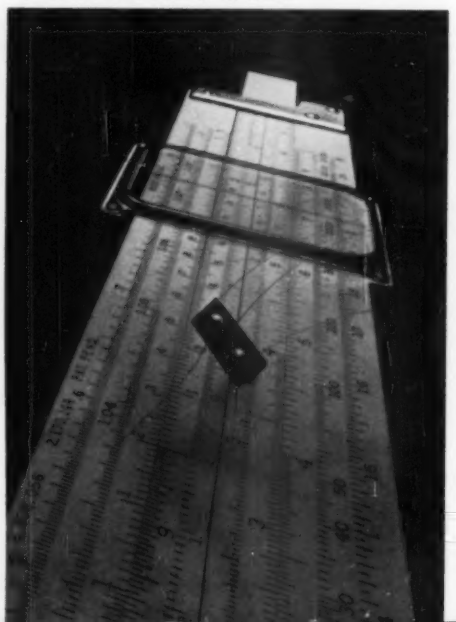
The molecular slide rule is the latest subsystem, or functional electronic block, to be demonstrated by Westinghouse through the principle of molecular electronics. The functions are performed by rearranging the internal structure of a solid semiconductor crystal. Electronic behavior occurring within or between regions in the crystal gives the same effect as an entire circuit.

The multiplying and dividing performed by the functional block is equivalent to that done by four separate diodes, or three diodes and a transistor. The functional block, however, is capable of greater accuracy than the assembly of individual components.

The molecular slide rule performs in a way similar to the conventional slide rule. An electric current fed into a semiconductor junction gives a voltage across the junction proportional to the logarithm of the current. An input of two currents into two junctions gives a voltage which is their logarithmic sum. The antilogarithm, measured at the output of the functional block, is the product of multiplying them together.

Just as in the conventional slide rule, division is the opposite process. The currents are fed into the multiplier-divider in such a way that their two logarithms subtract instead of add.

Both of these "slide rules" do multiplication and division in the same basic way: By logarithms



Pipe couplings and joints of all kinds may be made with either threaded parts or by using a solvent

Solvent Cementing

JOINING is no problem with these new plastic pipes. Just a dab of acetate solvent and they are permanently bonded. The pipes are coated, joined, given a twist, then held firmly a moment while the acetate forms a solid bond.

They can be cut to fit with an ordinary saw or bent to any desired curvature by heating. But, they are safely used to supply a home with hot water as well as cold.

The material the pipe is made from is called PVC (polyvinyl chloride)—one of the Geon vinyls made by B. F. Goodrich. It is said to resist deterioration from such things as alkalies, acids, metallic and ammonium salts, and organic media.

When compared to a steel pipe with the same wall thickness, the VPC pipe is less than $^1/_5$ the weight of the steel pipe.

Condenser Tube Study

SIXTEEN major power companies are co-operating with the producers of copper-base alloy condenser tubes in an evaluation of standard and modified alloys. These will include some new cupro-nickels for tubes in surface condensers.

The program is being co-ordinated by the Development and Research Division of the International Nickel Company, Inc. Their research has a twofold purpose. First, to determine the usefulness of newly developed copper-nickel alloys as tubes in condensers under various operating conditions and types of cooling water. Second, to compare the behavior of these new alloys with older condenser tube materials as used in the power industry.

A simultaneous study of all materials to be included in the field testing program will be made using clean sea water. Major testing will consist of installing the alloys as tubes in model condensers and studying their behavior at a tube water velocity of 10 ft per sec. Other tests will indicate the behavior of the materials in low, moderate, and high-velocity sea water. These tests will determine their resistance to pitting, impingement, corrosion-erosion, and other properties. The test program is expected to be in progress during the first quarter of 1962.

All companies in the program are co-operating with the understanding that the information obtained will be made freely available to other participants as well as to all others interested in the results.

Vinyl Toughens Waxes

WAX, particularly paraffin, is universally useful. It performs yeoman services for industries ranging from aircraft to textiles and from baked goods to electronics. It excels as a low-cost vapor barrier. But, it has an annoying trait—like a candle, it is brittle.

Du Pont has introduced a new series of vinyl resins under the trademark "Elvax," a copolymer of ethylene and vinyl acetate. Due to their high molecular weight and good compatibility, Elvax vinyl resins impart toughness, flexibility, and adhesion to paraffin wax and other brittle low molecular weight materials. The new vinyl resins which are described in the *du Pont Magazine* are expected to increase the use of wax in the paper, packaging, and adhesive industries among others.

Blends of paraffin wax containing 30 to 40 per cent Elvax can be applied to paper, film, and foil by hot-roll coating. The coating is completely flexible and provides water vapor barrier properties equivalent to laminations made with medium density polyethylene.

In adhesives, heat-activated coatings with Elvax should find immediate use, for example, with labels. Field tests show that, unlike present label coatings, which must be specially formulated for individual packaging films and other materials, Elvax provides universally strong adhesion to cellophane, polyethylene, foil, waxed paper, Mylar polyester film, and many other materials. The packaging and bookbinding industries are expected to find use for Elvax in hot-melt adhesives.

Since Elvax will be used in food-packaging applications, du Pont is currently completing a 19-month study as the basis for a petition to the Food and Drug Administration for permission to use the product in contact with foods.

Flexibility of a strip of wax-vinyl compound is shown here. Chief application will be in packaging.

The Air Force's Haystack Hill facility will look like this when completed. The 150-ft radome is the world's largest.

Largest Radome Completed

WHAT is said to be the world's largest radome was recently completed at Tyngsboro, Mass. It will shelter one of the most sensitive research antennas ever built, a 120-ft dish antenna that will play an important part in our global communications and space studies.

The radome contains more than a million and a half cu ft of space. It is 150 ft across at its widest point and 90 ft across at its base. The frame of the radome is made of hollow aluminum beams, some as long as 15 ft. The dome's skin is made of glass-fiber-reinforced plastic triangles. Each of the triangular panels is about the thickness of six sheets of writing paper. The 930 panels that make up the radome are connected in a carefully planned pattern of beams so as not to interfere with the radio beam of the radar installation. The completed dome is designed to withstand winds up to 130 mph.

The completed radome will protect engineers from the weather as they work on the foundations for the massive antenna. The entire facility is expected to be completed and go on the air by the end of 1962.

Gaskets Eliminate Door Latches

B. F. GOODRICH has a powerful flexible magnetic gasket that may eliminate the need for mechanical latching devices. The gasket is said to hold a metal door gently but firmly closed and provide a perfect seal. Without a mechanical latch, the manufacturer has more room and greater freedom of design.

The gasket consists of a length of flexible magnet encased in a balloon jacket of flexible Koroseal vinyl. (The magnet is a strip of Koroseal containing magnetized powder.) The gaskets were first used as refrigerator door seals on 1960 models.

A new gasket with stepped-up magnetic power permits use of a thinner strip inside the vinyl gasket than its predecessor. In addition to increased magnetic strength, the new gaskets are tougher and more pliable. These strips can be extruded in an infinite variety of shapes and sizes in any required length.

Numerical Control for Small Plants

PART programming on a computer is now economical for small job shops as well as large manufacturers. Univac solid-state computers are being equipped with a software package that enables them to generate part programs for numerically controlled machine tools.

For the industrial users of Univac solid-state computers, the new numerical programming control provides an opportunity for profitable fill in assignments for the computer that did not exist before.

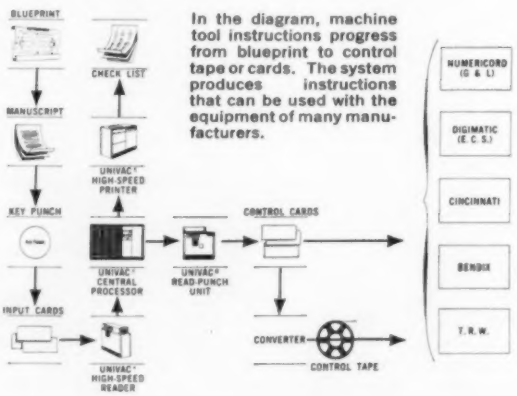
The programming system was developed jointly by Remington Rand Univac and Rohr Aircraft Corporation, for the Univac solid-state 80 and 90 computers. It greatly simplifies compiling of the complex instructions needed to guide numerically controlled tools in the machining of parts. A unique feature is the system's ability to guide the machine tool control devices of many different manufacturers.

Numerical control of machine tools has been practiced for some years in the aircraft industry. But where large computers have been unavailable, the manual preparation of machine tool guidance instructions has been costly, and sometimes impossible—particularly when the parts to be machined were of complex shape.

The new Univac program uses a part programmer's manuscript, a simple statement of manufacturing information prepared from an engineering drawing of the part. Cards are punched from this manuscript and fed into the computer where they are interpreted. Punched cards used to control the machine tools are then produced automatically by the computer.

Using machine tool instructions prepared on a computer, parts can be readily produced on what are known as "continuous path" machines. The computer's high speed rapidly defines and encodes thousands of instructions. It provides processing speeds up to 1,176,470 additions or subtractions per min; storage capacity up to 125,400 digits; and occupies only 500 sq ft of unobstructed floor space. The Univac's card reader can read and verify up to 600 cards a min. It prints up to 600 lines a min.

Programs for the tool control systems will be available to all users of Univac solid-state computers. In addition, metalworking firms operating on a job-lot basis can utilize the facilities of a Univac Service Center to perform automatic part programming. This service is expected to be especially important in enabling small



In the diagram, machine tool instructions progress from blueprint to control tape or cards. The system produces instructions that can be used with the equipment of many manufacturers.

and medium-sized firms or shops to obtain more fully the production benefits of numerical control. The cost of computer processing for these machines at Univac service centers for a part of average complexity is expected to range between $25 and $100.

Rare Earths

THEY'RE not rare, and they're not "earths," but that's the name they go by, and it takes a specialized plant to form them into parts for nuclear reactors. Such a plant has been built in the town of Great Barrington, Mass. There, Dresser Industries has established a small factory equipped to form and fabricate parts from these difficult, exotic metals such as zirconium, indium, columbium—the "rare earths."

This unique plant is the work of William O. Dresser, formerly with United Aircraft, who saw the need for an engineering establishment dedicated to bringing together the know-how and the equipment to handle the exotic metals. He has assembled a staff trained in the fields of theoretical and applied metallurgy and nuclear-control physics. Their work, so far, has been mainly in control rods and core structures for nuclear reactors, which demand the forming of the little-understood metals with accuracy bordering on perfection.

Rods of neutron absorbers, such as hafnium, are becoming more complex in shape, calling for a variety of welding and brazing methods. Such rods must be "clad" to survive in the reactor environment. Dresser has learned how to reduce cladding costs: They know what can be economically done. They have clad rare earths in stainless steel, cadmium, titanium, some silicates, nickel, and tin.

The rare earths are elements comprising more than 1/3 of the periodic table. They're abundant, but expensive to isolate. Zirconium is the seventh most abundant element available. The seemingly quaint location of Dresser Industries is actually quite central to sources of supply, and also to many users of nuclear-reactor material. The small, company airplane often delivers the finely wrought products.

One of the processes they are patenting is the closure weld on atomic fuel rods. The closure must be free of porous blow holes.

Dresser Industries expects that its capabilities in handling columbium and other high-temperature materials will involve them in the production of parts for rockets and space vehicles.

German Diesels for U. S. Railroads[2]

FOR the first time in over half a century, U. S. railroads have turned to an overseas manufacturer for motive power. Six 4000-hp German-built freight locomotives will soon be running on the rails of the Denver & Rio Grande Western and the Southern Pacific.

Krauss-Maffei of Munich, West Germany, built the locomotives that are the first ever fitted with hydrodynamic brakes. They are the diesel-hydraulic equivalent of the electrodynamic brake used on diesel electric locomotives.

Each 4000-hp locomotive is an A unit mounted on a pair of three-axle trucks. Each truck is individually powered by a 2000-hp diesel. Prime movers for the locomotive are a pair of Maybach MD 870 four-stroke, 16-cylinder engines. Each V-16 engine is supercharged and equipped with aftercoolers. The engine has a continuous rating of 2000 hp at 1585 rpm under standard International Railway Union conditions.

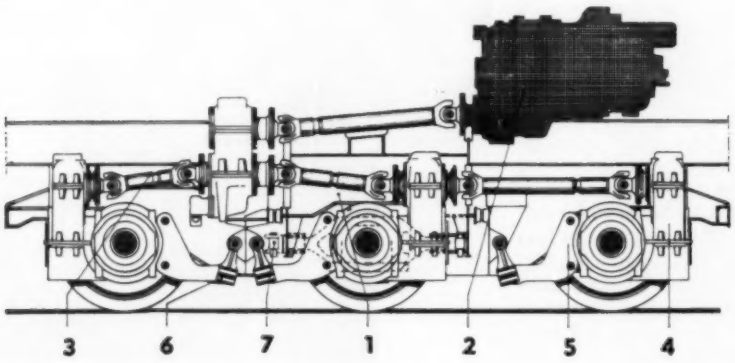
The 4000-hp unit has fully hydrodynamic transmission—the Voith Type L8-30rU, with three Fottinger torque converters. Each has a built-in reversing gear and a hydromatic brake attached. Each torque converter consists of a driving pump impeller, driver turbine runner, and a fixed stator or guide ring.

The Voith hydrodynamic braking system is based on the principle of the Froude water brake in which energy is dissipated in eddy formation and heat. The brake has a double-entry rotor and a fixed stator with two sets of blading to match the rotor. The brake attaches directly to the output of the Voith transmission. Filling and emptying the hydraulic circuit control braking which is divided into eight steps.

In each truck a shaft extends from the transmission to an intermediate gearbox on the truck frame. From there, shafts drive the axle units.

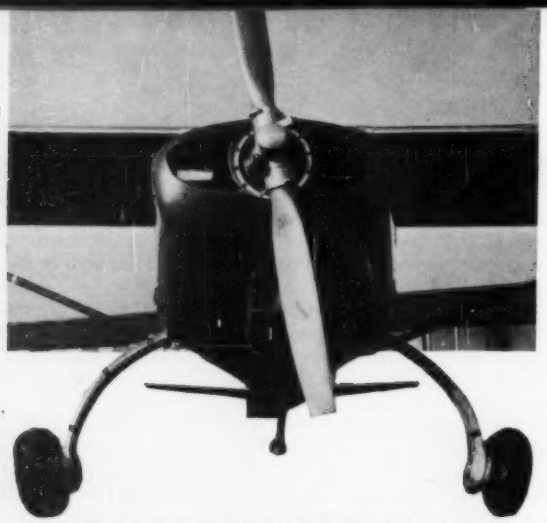
The unit's controls are fairly simple. A single master controller regulates both power and braking. The drive side of the controller has 17 steps. At step one, the first stages of the converters are partially filled, permitting slow and carefully controlled movement. At step two, the starting converters are filled to normal level ready for operation. Steps three through 17 gradually increase engine output up to full power. On the opposite side of the controller are the eight steps of hydrodynamic brake control.

[2] Condensed from an article titled, "Diesel-Hydraulics in Service Soon," which appeared in the September, 1961, issue of *Railway Locomotives and Cars*.



Diesel-hydraulic has replaced diesel-electric in these new German locomotives. The 3-axle truck, one of two on each unit, is powered directly by a diesel engine. Truck components are:

1 Main frame extension
2 Hydraulic transmission
3 Cardan shaft
4 Axle gear drive unit
5 Torque support
6 Torque support suspension element
7 Guide linkage



Glass fiber gives this experimental landing gear exceptional durability and strength for rough landings

Glass-Fiber Landing Gear

A SWEDISH aircraft manufacturer is now testing an experimental glass-fiber reinforced plastic landing gear. This is reported to be the first such use of the material in the aircraft industry. In tests on very rough terrain, the gear showed good shock absorption and damping characteristics. Taxiing was also smoother because the gear transmits less vibration to the plane.

By using a special winding technique, the manufacturer, AB Malmö Flygindustri, builds a modulus of elasticity into the gear that suits the weight of the aircraft.

Polyester and epoxy material have been tried in the landing gear, with best result given by the epoxy.

The plane using the new landing gear is also in the experimental stage. It is a 4-passenger, single-engine craft, designated the MFI-10 Vipan. The design combines light alloys and reinforced plastics for sandwich construction in the fuselage, wings, and control surfaces. Range of the plane is about 620 mi.

Water Contamination Test

A SIMPLE way to detect possible contamination of a water supply has been reported to the American Chemical Society by a Philadelphia chemical engineer.

Anyone can use a glass bottle test to determine whether trace amounts of detergents or other organic materials are present in a river or well, according to George J. Crits, assistant technical manager of the Cochrane Division of the Crane Company. Water sources are becoming more and more contaminated with such materials, which can produce bad tastes in water and, consequently, in drinks like coffee, tea, and fruit juices. What is more important, the presence of detergents or soaps may indicate that a water supply is contaminated by leakage from a nearby sewer or cesspool.

The test works as follows: Take a tall, cylindrical bottle, similar to an olive bottle, and fill it half full with the water sample, then seal it. Shake the bottle. If detergents or soap are present in high amounts, a noticeable foam forms. But, small amounts, which are still objectionable, do not cause foam. Instead, a thin film forms and travels upward on the side of the bottle. The film rises until it disappears at a height dependent on the contamination in the water. A ring measuring $^3/_8$ to $1^1/_2$ in. high indicates the presence of 0.3 to 3 parts per million of detergent in water.

Sports Engineering

WHAT has engineering to offer the sports world? You may see one answer next spring—a magnesium baseball bat.

A number of major leaguers tested the magnesium bat last season. Most of the players handling the new plastic-covered, metal bat were unable to distinguish any difference in its performance from their wooden bats. They liked the fact that it had no "sting" when hitting the ball. Because it is said to outlast the traditional wooden bat, the magnesium bat may capture a big share of the $6 million per year bat market.

Feature of the magnesium bat is that it is uniform in weight—within $^1/_4$ oz. This has been a problem with white ash, traditional source of baseball bats. Being a product of nature, the wood would have soft spots, whereas the magnesium-cast bat is perfectly uniform.

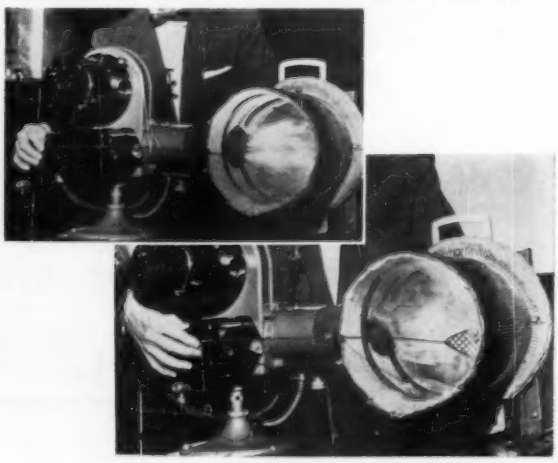
Magic Grid

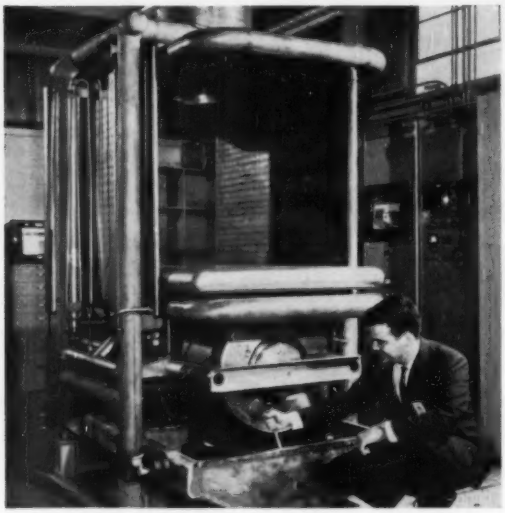
You would suppose that combustion in home oil burners had long since been researched and perfected to the nth degree—but you would be wrong. Humble Oil's affiliate, Esso Research and Engineering Company, has recently completed a study of the combustion process at the nozzle of the familiar oil burner. Results: (*a*) The combustion is less than optimum; (*b*) it can be markedly improved by the placing of a metal grid in the path of the flame, at the right distance in front of the nozzle.

In its study, Esso constructed a combustion chamber with quartz windows, and used a stroboscopic high-speed camera. They discovered that no combustion was occurring in the central region of the flame pattern, where the greatest concentration of fuel exists—and where the highest level of combustion should take place. The flame pattern was hollow in the center.

Screening the flame at its source eliminated this defect. They tested a variety of grid designs; now they are marketing a grid of a nickel alloy under the trade name of "Magic Grid." When properly adjusted to the individual installation, the grid will give cleaner heat, reduce noise, and result in economies that can run as high as 20 per cent.

With a properly adjusted grid, the oil burner, **above,** has a clean efficient flame. **Below,** without the grid in place, combustion is imperfect.





This elaborate device is needed to accurately measure the small thrusts of a plasma engine

Thrust Measuring System

THE ion propulsion system engines described in November MECHANICAL ENGINEERING, p. 74, have very light thrusts; in present prototypes, just a few lb. To test these electrical propulsion systems, Rocketdyne has built a thrust measuring device. It is a $2^1/_2$-ton machine so sensitive it can measure the force of a human breath—about 0.001 lb. The maximum thrust it is designed to take is 10 lb. The system can support an engine weighing up to 200 lb and as large as 3 cu ft.

During a test the system supports the propulsion system on a pendulum. The engine's thrust moves the suspension freely the way a porch swing moves in a breeze. This movement activates an electromechanical system which balances the thrust force with an opposite force generated by a magnetic force motor. Thus the suspension remains stationary and the amount of current needed to keep the suspension in balance serves to measure the amount of engine thrust.

New Equipment From Burroughs

BURROUGHS Corporation has entered the punched-card electronic computer business to compete for the billion dollar a year market in automatic business data-processing equipment. The company's program includes a new family of solid-state computer systems, an expanded customer training program, an increase in the data-processing sales and technical support force, and a stepped-up manufacturing program.

The basic punched-card system in the new Burroughs B200 series is called the B260. It is the first completely integrated, moderately priced system designed especially for the punched-card market, according to the company president.

The new series also includes the B280, a magnetic tape system, and the B250, which has a hard-copy record processor in addition to punched-card handling equipment. A fourth system in the series, the B270, was introduced earlier this year. It is suited to financial data-processing applications because it can accept documents encoded with magnetic ink as well as punched cards.

The new Burroughs system is said to be the only one in its price class that utilizes two high-speed card-reading units. This feature doubles input speed and, in many applications, eliminates much of the sorting and rehandling of cards now necessary before they are fed into the system.

One contribution to greater productivity is the system's internal buffering, which allows simultaneous, continuous operation of all system components at their true maximum speeds. Another innovation in the computing systems is the card feed. B200 system card readers pass cards by using an electronic impulse to trigger a magnetic band, rather than engaging a mechanical clutch to move a card into the read position.

Burroughs has also simplified the process for preparing written instruction for the machine by reducing the basic computer commands to less than 20.

A complete punched-card electronic computer system will sell for $183,650 and rent for $3750 monthly. Sales prices of magnetic tape systems will range from $252,180 to $384,780, with monthly lease rates extending from $5235 to $8435. First deliveries of B200 systems will be made in the Fall of 1962.

Steam for Chemical Processing

SUPPLYING steam for chemical processing is the task of a Vogt steam generator now operating at the Olin Mathieson Chemical plant, Brandenburg, Ky. The unit is six stories high and built out in the open with only the firing equipment housed. Outdoor installation was no problem. Only rain flashing was needed on corners and where the boiler passes through the wall of the building housing the control and fire equipment. All other standardized equipment was waterproof by design.

The generator has a capacity of 165,000 lb of steam per hr at 650 psig and 750 F, total temperature. Operating efficiency is 85.2 per cent.

There is 14,050 sq ft of heating surface in the boiler and a projected water wall surface of 2612 sq ft. Furnace volume is 11,760 cu ft. Tangent tubes make up the engine water-wall surface. The side walls at the lower portion of the furnace are vertical and front and rear walls incline to form a hopper to discharge ashes.

Pulverized coal is burned in the four burners. Each burner has a gas-electric ignitor. Instruments to control combustion are housed in a console-type cabinet, including a multipoint strip chart recorder that monitors temperature throughout the unit.

Steam for a chemical process is generated at the rate of 165,000 lb per hr in this six-story unit

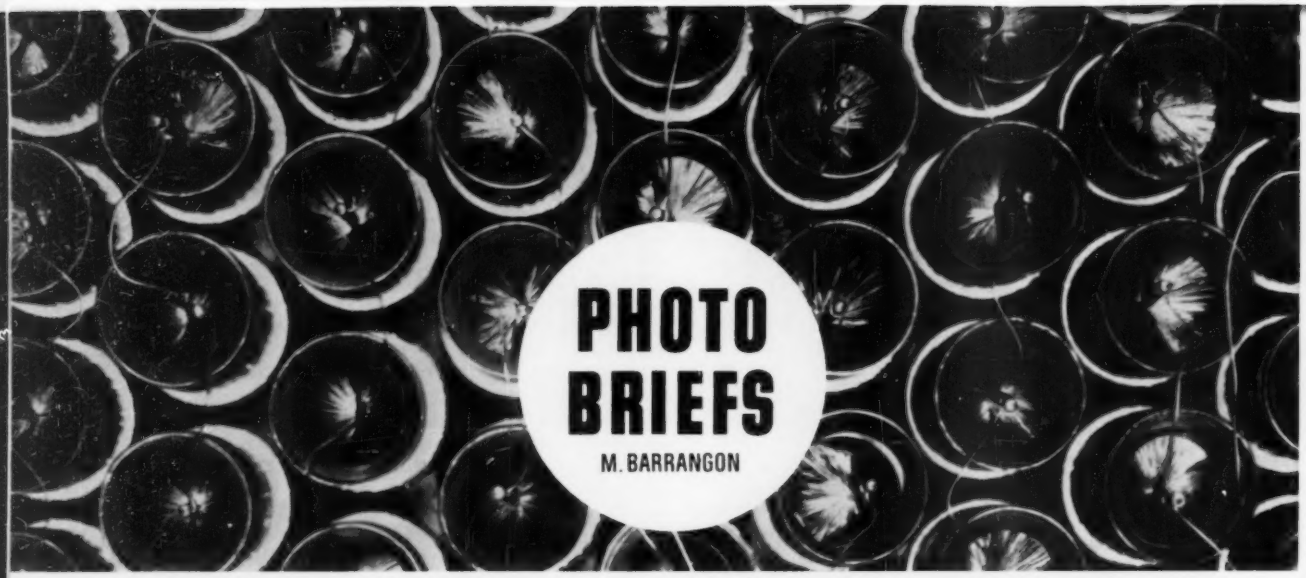
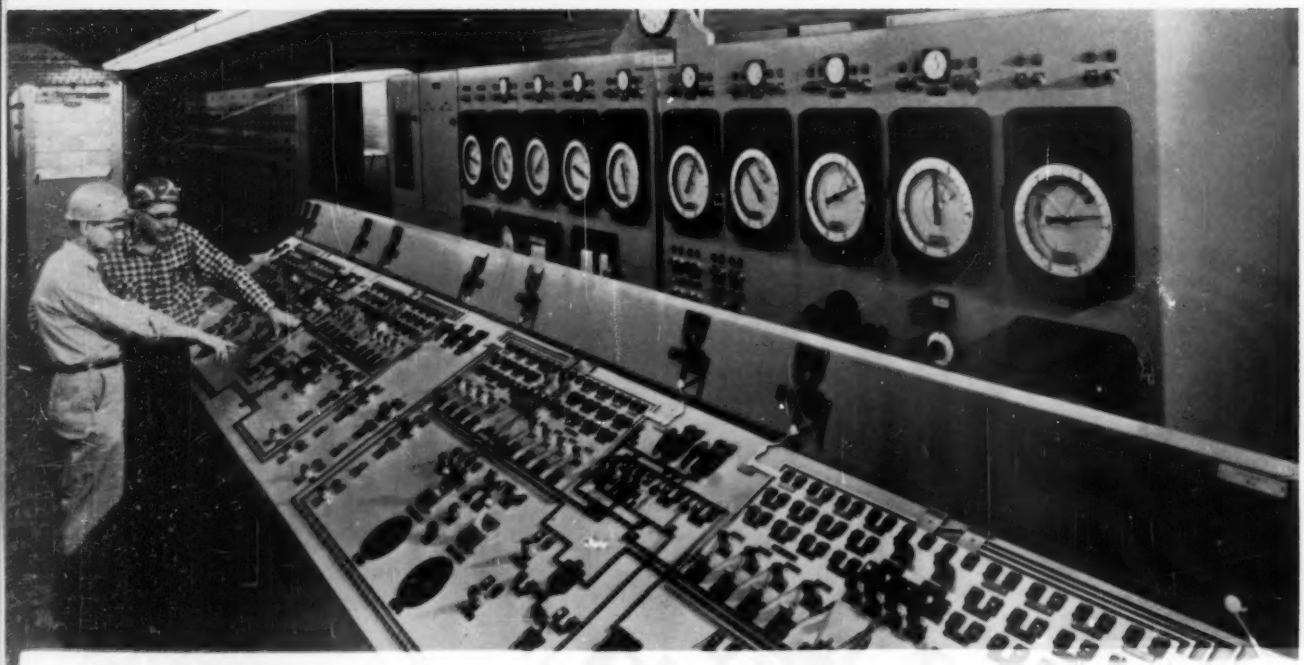
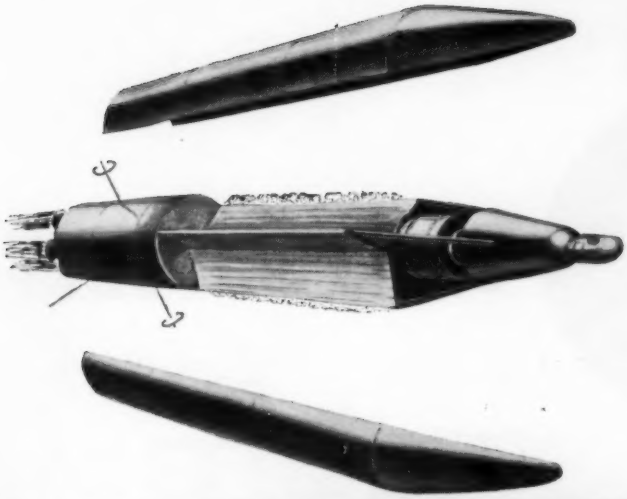


PHOTO BRIEFS

M. BARRANGON

OZONE BY THE TON. You could guess almost anything for this picture, **above,** but it's actually the inside of an ozone generator one of the units in a new ozone-oxidation plant recently put on stream by Emery Industries, Inc., Cincinnati, Ohio. Each circle is the end of a glass tube approximately 3 in. in diam. Ozone is produced by subjecting oxygen to a high voltage where a silent electrical discharge converts it to ozone. **SMOKE CONTROL.** Automatic control of smoke and gases, **below,** from 10 open-hearth steel furnaces is concentrated in this visualized flow-control console at U. S. Steel Corporation's Geneva plant in Utah. Dust and fume particles are removed from the stack gases by electrical precipitators manufactured by Research-Cottrell, Inc., Bound Brook, N. J. The automation system, also by Research-Cottrell, makes high-speed adjustments which even full-time human surveillance could not detect or react to fast enough to keep pace with the 10 furnaces. **FLYING ATOMIC REACTOR.** That rocket, **opposite, top,** contains an atomic reactor designed to convert heat directly into electricity—a thermionic-reactor system. The Martin Company, Baltimore, Md., has completed advance design work on such direct-conversion systems in the 60 and 300-kw ranges, with a 2000-kw reactor under conceptual development. Martin considers this the system of choice for use in space, as against mechanical units. The latter require turbines, while a thermionic system produces energy without moving parts, offering higher reliability and greatly reducing the problem of preventing rotation in space. **MULTILAYER PRESSURE VESSEL.** The Process Equipment Division of A. O. Smith Corporation, Milwaukee, Wis., built this multilayer pressure vessel, **center,** for what may be the world's most powerful hydraulic press. Multilayer construction is a process whereby relatively thin layers of steel are applied one at a time and are progressively wrapped in a machine designed to obtain tightness between layers. This 103-ton vessel, 56-in. ID and 16 ft, 3 in. long, is for a press built by Verson Allsteel Press Company, Chicago, Ill., and Dallas, Tex., which is rated at 41,000-ton capacity, and will be used in the forming of metal for missiles and aircraft. **HIGH-SPEED, HIGH-DRAG LOCOMOTIVE.** The Electro-Motive Division of General Motors, La Grange, Ill., has introduced this new 2250-hp locomotive, **bottom,** claimed to be the "widest-range locomotive on the rails today." Prime mover for the GP-30 is the General Motors 567-D3 diesel engine featuring a turbo-charger that operates by direct drive from the engine gear train at low speed, but as a free-running turbine at higher engine speeds. Engine efficiency is maintained in high-altitude operation.






1962
1962
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Engineering Progress in the British Isles and Western Europe

J. FOSTER PETREE
European Correspondent

EUROPEAN SURVEY

Vickers-Armstrongs' VA-1 research hovercraft, **below**, hovers on a cushion of air 4 in. over its own shadow. The amphibious craft also will ride over water, **left**.

Hovercraft Developments

Over a year ago the British shipbuilding, aircraft, and engineering firm of Vickers Limited, London, entered into an agreement with Hovercraft Development Ltd. to collaborate in the production of this novel type of craft which rides on a film of air forced beneath the hull by fans and travels over land or water with equal facility.

A research hovercraft, the VA-1, was built and tested over land at an all-up weight of 3300 lb. It hovered at a height of $4^1/_2$ in. The initial equipment was limited to the bare essentials, but later a cabin and various fairings were added in preparation for over-water tests. This increased the weight to 3500 lb and reduced the hover height to 4.1 in. The fan engine is a Gipsy Major of 120 bhp, a type normally used for powering light aircraft. A small Rolls-Royce Continental engine of 150 hp drives an air propeller to give forward motion. In a recent trial on Southampton Water, a fairly open estuary, a speed of 30 knots was maintained without difficulty and a steady course held in a breeze of 15 to 20 knots and waves of 18 in. to 2 ft in height.

Experience with the VA-1 has been so satisfactory that two more craft were developed and are now under construction. The first of these, the VA-2, is designed as a utility craft to carry four or five people, with a speed of 40 knots and an endurance of $1^1/_2$ hr. It will have a length of 28 ft 4 in., a breadth of 14 ft 10 in., and a height of 10 ft 4 in. It will be driven by three light aircraft piston engines, two for lift and one for propulsion, and will hover over a solid surface at a height of $8^1/_2$ to 9 in. It can be separated into three sections for loading into British transport aircraft as it is intended to be used for demonstration purposes in any part of the world.

The VA-3, also being built, will have an all-up weight of about 10 tons and is designed to carry 24 passengers in addition to the crew. It measures 52 ft 6 in. long, 25 ft broad, and 17 ft 9 in. high, and will have engines of 1600 hp, enabling it to hover at a height of as much as 3 ft. For survey or exploration work, a cargo deck will take the place of the cabin. The craft will then carry about 4000 lb load, plus crew, for 80 nautical miles. The speed range is from 30 to 150 knots, with a cruising speed of 60 knots. There will be four Blackburn Turmo 603 turbine engines, two for lift and two for propulsion, the latter driving four-bladed variable-pitch reversible propellers.

Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.

Automatic pressure-greasing equipment for the lubrication of pins, links, and rollers of chain conveyers. See story below for explanation of diagram.

The Unidachs digger with rotatable telescopic boom demonstrates its capabilities. It can operate around a 360-deg swing. The machine can convert to a digger, scraper, or crane. Hydraulic system has spare take-off points.

Automatic Lubrication of Conveyers

De Limon Fluhme & Co., Arminstrasse 15, Düsseldorf, Germany, have developed an automatic grease injection system for the lubrication of the pins, links, and rollers of chain conveyers as they travel over the sprockets. The grease is supplied by a motor-driven pump, 3, through pipeline at a pressure that may be up to 1700 psi, through the hollow spindle of the sprocket and thence by a flexible connection, 7, to the injection nozzle, 1, which is mounted in a bracket, 2, attached to the sprocket and revolving with it. The nozzle, 1, is concentric with a ram, actuated by the grease pressure, which has an axial movement sufficient to enable it to be forced into contact with the nipple on the link pin.

While it is held there, a rotary distribution valve, 6, attached to the end of the sprocket spindle, opens to allow the injection of grease into the nipple by an accurately metered amount. Shortly before the chain pin disengages from the sprocket, the valve cuts off the supply from the nipple and connects it to a return pipeline, 8, not under pressure, coupled to the grease-pump suction. Simultaneously the injection nozzle is withdrawn. A spring-loaded accumulator, 5, maintains a uniform pressure in the supply system.

The frequency of injection depends on the ratio of the number of sprocket teeth to the number of chain links. For example, with a seven-toothed sprocket, each link pin would receive an injection for every seven complete circuits of the conveyer chain. The injection nozzles are fitted in pairs, one on each side of the chain, and act in unison to feed in grease at both ends of the link pin. Thus there is no unbalanced side pressure on the chain.

All-Around Digger

The German firm of Wieger-Maschinenbau G.m.b.H., makers of excavating machinery, of Neuss (Rhein), showed at the 1961 German Industries Fair a crawler-mounted excavator possessing some unusual constructional features. It is known as the "Unidachs" and can operate around 360 deg of swing, to angles of 30 deg above ground level or 40 deg below. The telescopic boom of welded plate is triangular in section and extensible from a length of 5 m (16 ft 5 in.) to 9 m (29 ft 6 in.). It is carried in a welded steel frame, mounted in trunnions to swing vertically. Within that frame it can rotate on its own axis (at any angle of elevation or depression) so as to cut sideways in either direction. All motions are hydraulically actuated, and any or all of them can be used simultaneously.

"Spey" Engine Airborne

Coincident with the appearance of the October, 1961, "European Survey," on page 78 of which was an article on the Rolls-Royce Spey bypass jet aeroengine, Rolls-Royce began flight trials with two of these engines in an Avro Vulcan "test bed" aircraft. The flight trials took place within ten months after the Spey first ran. During that period, the test engines ran over 1300 hr, including a preliminary 150-hr test to the combined type-test schedule of the (British) Air Registration Board and the Federal Aviation Agency.

Substance in Brief of Papers Presented at ASME Meetings

KAREN SODERQUIST
Editorial Asst.

ASME TECHNICAL DIGEST

Materials Handling

Improved Hopper Cars for Bulk Shipment of Materials . . 61—BSH-2 . . . By LeRoy Kramer, Jr., General Americar Transportation Corporation, Chicago, Ill. 1961 ASME Bulk Solids Handling Symposium paper (multilithographed; available to Aug. 1, 1962).

The development of railroad equipment designed to handle dry, powdered, granular, or pelletized materials in bulk is discussed, as well as the design of such modern covered hopper cars in response to industry's demand for reductions in material-handling costs and improved efficiency in unloading by mechanical or pneumatic methods. Possible future trends in similar rail cars are also mentioned.

To expand the field of rail bulk transportation of dry powdered or granular materials, the Airslide car was developed in the late 1940's. This improved covered hopper car was produced at the request of a major flour milling company to solve the problem of shipping flour in bulk.

The Dry-Flo car is built to the exact design of the Airslide car with the exception of the bottom hopper sheets. The newer car was designed for gravity discharge since it is used for those free-flowing commodities too coarse for fluidization by the Airslide principle. Both of these cars are described.

Design and Application of Precast Concrete Stave Silos . . 61—BSH-3 . . . By H. Dale Webb, American-Marietta Company, Marietta, Ohio. 1961 ASME Bulk Solids Handling Symposium paper (multilithographed; available to Aug. 1, 1962).

Although the concrete-stave silo was once thought of only in conjunction with farm storage of silage, its economy and durability have made it a permanent part of the field of industrial storage and material handling.

The combination of the precast concrete-stave silo and galvanized-steel rods, or hoops, built into a cylinder gives an inherently strong structure. When properly designed and erected with trained personnel, it is capable of storing hundreds of tons of free-flowing, granular materials. Its design, erection, and applications are discussed.

Automation and Control of Proportioning Systems . . 61—BSH-4 . . . By Ingram H. Richardson, Richardson Scale Company, Clifton, N. J. 1961 ASME Bulk Solids Handling Symposium paper (multilithographed; available to Aug. 1, 1962).

There is scarcely an industry involving loose bulk materials that does not call for measurement of these materials to process, that is proportioning. Not too long ago this was done by hand with manual hopper scales for larger quantities, and by so many scoops from a cracker barrel for the small ones.

Automation in proportioning is growing at a fabulous rate, not only in the breadth of its application but also in complexity as it embraces an ever-increasing number of alternatives for weight sensing, programming, readout, and co-ordination of other elements involved in the over-all process control.

To survey the accomplishment in the process industries over the past 10 years is to realize how difficult it is to select the proper system for a specific application. Yet this selection is a practical assignment which materials-handling engineers must cope with, and it is the purpose of this paper to recommend a procedure that will be helpful in such assignment.

Selection and Application of Continuous Weigh Feeders..61—BSH-5... By A. G. van Stolk and D. B. Boeck, Wallace and Tiernan Inc., Belleville, N. J. 1961 ASME Bulk Solids Handling Symposium paper (multilithographed; available to Aug. 1, 1962).

Continuous weigh feeders can be grouped into two categories: those which preweigh the hopper and the material to be fed, and those which postweigh the material; that is, weigh the material after it has left the hopper.

Design of continuous gravimetric feeders, whether preweigh or postweigh, is based on variations of two major components. The first is a feed section that volumetrically regulates the flow rate in accordance with a signal from the weight-sensing element. The second is the weight-sensing element through which the weight difference is transformed to a signal capable of inducing mechanical correction of the flow rate of material.

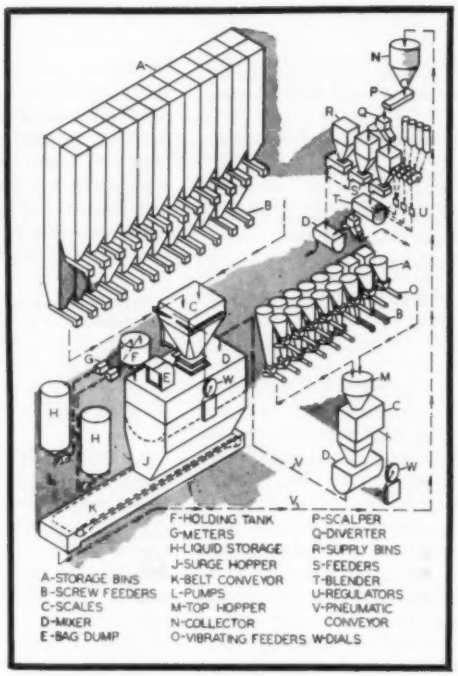
Operating principles of the continuous weigh feeders available and the considerations for selecting a certain type of feeder for a specific application are discussed.

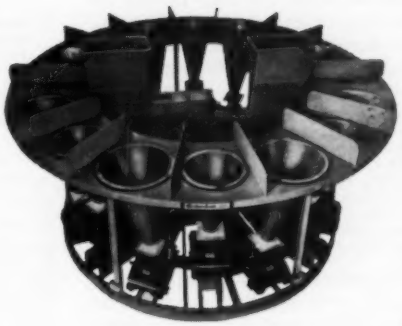
Design and Application of Closed Loop Pneumatic Conveyer Systems...61—BSH-6... By Henry T. Young, The Young Machinery Company, Inc., Muncy, Pa. 1961 ASME Bulk Solids Handling Symposium paper (multilithographed; available to Aug. 1, 1962).

Closed-loop pneumatic conveyers are particularly applicable where bulk materials must be kept free of contamination, moisture, or oxygen, or may be unsuitable for separation in a cloth filter.

Under basic design concepts, the paper describes the product flow from the inlet air-lock feeder through the convey pipe to a cyclone and out through a discharge rotary airlock, and the return of the cyclone-cleaned air through the heavily built turbine fan back to the pick-up point. Typical components, including rotary valves, cyclones, and specially built turbine fans, and typical installations are described.

A microblending system for automatically proportioning a number of small ingredients. Control panel, **below left**, regulates system of conveyers, blenders, and pumps in diagram, **right**. At **far right** is "library" of portable containers positioned around central weighing station (61—BSH-4).





Methods of Transporting, Handling, and Storing Coal..61—BSH-7... By V. A. Frawley, Mem. ASME, and V. H. Wood, Northern States Power Company, Minneapolis, Minn. 1961 ASME Bulk Solids Handling Symposium paper (multilithographed; available to Aug. 1, 1962).

Policies and practices followed by the author's company in the transportation, handling, and storage of coal are described as well as two general factors associated with the movement of coal: (*a*) advanced planning of handling and shipping schedules and (*b*) installation of the ultimate in equipment to increase unloading rates and reduce labor expense, not considered the most economical solution in all coal-handling situations.

Getting "Difficult" Materials Out of Bins..61—BSH-8... By A. D. Sinden, Mem. ASME, Stephens-Adamson Manufacturing Company, Aurora, Ill. 1961 ASME Bulk Solids Handling Symposium paper (multilithographed; available to Aug. 1, 1962).

Where material characteristics and bin requirements are such that neither gravity flow nor vertical-wall, live-bottom construction are practical, a hopper-bottom bin with flow inducers is indicated. Although flow inducers may be vibrators, pulsators, air streams, or nontraveling mechanical dislodgers, the only way to be sure that any of these in an untried setup will produce unfailing discharge is to cause positive displacement of material over the entire hopper surface.

Comparative tests are described of various bin-discharging devices with special emphasis on apparatus called a "planetary arch breaker."

Dry Bulk Trailer Equipment..61—BSH-10... By Robert M. Geisenheyner, Butler Manufacturing Company, Minneapolis, Minn. 1961 ASME Bulk Solids Handling Symposium paper (multilithographed; available to Aug. 1, 1962).

Pneumatic conveying is recognized today as a means of reducing costs by utilizing truckers' shipping containers on wheels with built-in material-handling systems which result in controlled inventories and increased profits.

As the cement industry from New York to Virginia established this type of delivery, the demand also spread into areas never before offering truck shipments. This expansion continued until today most of the producing cement mills depend to a great extent on truck equipment for delivery of their product.

To provide equipment to service this new transportation requirement for dry bulk products, a variety of trailer designs appeared on the market in 1959 and continues to appear today.

One phase of this broad field—truck transportation of dry flowables using a pneumatic system for unloading the product—is discussed.

Air Pollution Considerations in Bulk Handling Operations..61—BSH-11... By Malcolm E. McLouth, Assoc. Mem. ASME, Control Engineer, City of Minneapolis, Minneapolis, Minn. 1961 ASME Bulk Solids Handling Symposium paper (multilithographed; available to Aug. 1, 1962).

As real-estate values increase, remotely located bulk-handling operations suddenly find themselves surrounded with residences. Clouds of dust are no longer described as a healthy sign of activity but as distasteful nuisances.

This industry is now confronted with an air-pollution problem that in some cases can threaten its very existence. Pollutants that can be troublesome are discussed with emphasis on dust. Some fall-out data in a grain-handling area are presented. The coal, sand, and gravel, and other industries also are discussed.

Several references are given for the engineer with specific air-pollution problems in bulk materials handling.

Metals Engineering

Low Temperature Properties of K-Monel, Inconel-X, René 41, Haynes 25, and Hastelloy B Sheet Alloys..61—WA-12... By J. F. Watson and J. L. Christian, General Dynamics Corporation, San Diego, Calif. 1961 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1962).

The use of cryogenic propellants in current and proposed missiles and space vehicles has focused attention on the properties of high-strength structural materials at −297 and −423 F (the boiling points of oxygen and hydrogen).

It was the purpose of this program to investigate the mechanical properties of a series of nickel and cobalt-base alloys at cryogenic temperatures, and to correlate these properties with chemical analysis and microstructures resulting from both cold work and heat-treatment. Since both toughness and weldability are of practical importance in the design of airborne cryogenic fuel tanks, the notched tensile strengths (K_t = 6.3), and welded joint properties were determined in several cases.

This investigation was limited to sheet material since primary interest is

in thin-walled pressure vessels. The nickel and cobalt base alloys used in this investigation and their history and chemical analyses are listed. The materials were tested in various conditions of heat-treatment and cold work.

Dynamic Elastic Modulus Values at Room and Elevated Temperatures of Some Materials for Missile Applications..61—WA-13 ... By T. W. Gibbs and C. L. Theberge, Avco Corporation Research and Advanced Development Division, Wilmington, Mass. 1961 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1962).

The modulus of elasticity has been measured by a dynamic resonant beam technique for a number of high temperature metallic, ceramic, and plastic type materials at room temperature and in many cases at elevated temperatures to 1800 F. Some values of the modulus of rigidity and Poisson's ratio have been measured by the same technique and are reported.

The Effect of a "V" Notch on the Tensile Creep Behavior of Cr-Mo Steel..61—WA-16... By Yoshitada Suezawa and Hidemitsu Hojo, Tokyo Institute of Technology, Tokyo, Japan. 1961 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1962).

Effect of a "V" notch on the tensile creep behavior of Cr-Mo steel at elevated temperature was studied for the reasons for notch strengthening or notch weakening. Special attention was paid to changes in notch profile and dimensions, as well as to structural changes of the notched portion of the specimens with the lapse of time up to rupture.

Interesting results were obtained different from those of an ordinary tensile test or a creep test on smooth bars. They are useful to the complete analysis of the stress distribution at the notch-root section of the notched specimens at any time after loading and, in turn, to clarify reasons for notch strengthening.

Design of Pressure Vessels for Low-Cycle Fatigue..61—WA-18... By B. F. Langer, Fellow ASME, Westinghouse Electric Corporation, Pittsburgh, Pa. 1961 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1962).

Methods for constructing a fatigue curve based on strain-fatigue data for use in pressure vessel design are described. When this curve is used, the same fatigue strength-reduction factor should be used for low-cycle as for high-cycle conditions. When evaluating the effects of combined mean and alternating stress, the fatigue strength-reduction factor should be applied both to the mean and the alternating component, but then account must be taken of the reduction in mean stress that can be produced by yielding.

Complete fatigue evaluation of a pressure vessel can be a major task for the designer, but it can be omitted or drastically reduced if certain requirements regarding design details inspection and magnitude of transients are met.

The same principles could be applied to any structure made of ductile metal and subjected to limited numbers of load cycles.

Cumulative Fatigue Damage With Random Loading..61—WA-31... By R. R. Gatts, Assoc. Mem. ASME, General Electric Company, Schenectady, N. Y. 1961 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1962).

A general concept of the accumulation of fatigue damage is applied where stress amplitude is a random time function with a specified amplitude distribution. A differential equation relating damage accumulation to the amplitude distribution of stress is derived.

This equation is applicable to both continuous and discrete distributions. Solutions of the equation are used to predict life under random loading on the basis of constant amplitude S-N data. Such predictions are compared for both continuous and discrete stress amplitude distributions and found in better over-all agreement with the data than comparable predictions by the linear rule.

Effect of Cell Geometry on Proportional Limit Shear Stress of Metallic Foil Sandwich Panel Core..61—WA-34... By I. K. Ebcioglu, J. J. Baltes, and C. C. Chang, University of Minnesota, Minneapolis, Minn. 1961 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1962).

A simple analytic theory for the effect of cell geometry on the proportional limit shear stress of metallic foil sandwich panel cores is presented. The core efficiency factor $(a\ \tau_{\theta_p})/(t\ \tau_p)$ is plotted against θ for given α and different value of b/a. The present theory is compared with some available experiments. The theoretical values of proportional limit shear stresses can be taken as a first approximation for the exact values, but they are usually higher than the corresponding average experimental values.

The Failure of 304 Stainless Steel by Thermal Strain Cycling at Elevated Temperature..61—WA-200... By Arnold E. Carden, Assoc. Mem. ASME, and Jan H. Sodergren, University of Alabama, University, Ala. 1961 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1962).

Four $1^1/_2$-in-diam CG annealed 304 stainless-steel bars were used.

A relationship between the number of cycles to failure and the plastic strain range per cycle for the stainless steel from cyclic thermal strain data are determined. These data are compared to mechanical strain cycling data (isothermal) and values based on $\epsilon_p N_f^{1/2} = C$

Machine Design

Load-Deflection Behavior of Conical Spiral Compression Springs..61—WA-128... By Han-Chung Wang and Will J. Worley, Mem. ASME, University of Illinois, Urbana, Ill. 1961 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to Oct. 1, 1962).

The geometry of both the Archimedean and the logarithmic spiral, when formed into the third dimension, is considered. Changes in profile resulting from the choice of constant helix angle and from constant spacing between adjacent coils along the axis of the conic are presented.

The axial and lateral load-deflection behavior of conical spiral springs is considered in terms of the above variables. Strain-energy methods are used to obtain the load-deflection relationships.

Nonlinear effects due to compression of the large diameter coils are discussed.

Design of an Epicyclic Gear Train by Use of a Digital Computer..61—WA-126... By D. E. Clancy, Assoc. Mem. ASME, Philco Corporation, Sunnyvale, Calif.; and D. R. Doering, Assoc. Mem. ASME, The National Cash Register Company, Dayton, Ohio. 1961 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1962).

A unique use of an epicyclic gear train to furnish equal bidirectional outputs from a unidirectional input, is described. The equations of motion are derived and reduced, and the method by which a digital computer was utilized in the derivation of the solutions is outlined.

By applying computer techniques to this design problem, the solutions were obtained rapidly and accurately. The designer was freed of the laborious task of deriving the solutions and had only to make a final selection based on cost and availability of the gears.

Some Simplified Solutions for Relatively Stiff Beams on Elastic Foundations..61—WA-3... By Bernard W. Shaffer, Mem. ASME, New York University, New York, N. Y. 1961 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to Oct. 1, 1962).

Maximum bending moments, rotations, and deflections of beams resting on

elastic foundations and subject to central forces and bending moments are computed on the basis of a linear approximation to the foundation reaction. This reaction is determined from the rigid-body motion of the beam, and is thus statically determinate.

The results of these approximate analyses are compared with those obtained from the exact theory in terms of the "characteristic parameter" of the beam, which is a function of the relative stiffnesses of the beam and the foundation. It is shown that the approximate analysis introduces very little error if the beam is stiff as compared to the foundation on which it rests.

Torsional and Longitudinal Vibrations of Variable Section Bars..61—WA-75... By O. H. Griffith, Assoc. Mem. ASME, Lockheed Aircraft Corporation, Sunnyvale, Calif.; and E. T. Cranch, Mem. ASME, Cornell University, Ithaca, N. Y. 1961 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1962).

Frequency equations are determined for torsional oscillations of compound bars. The compound bar has one uniform segment and one or two variable section parts in which the linear dimension of the cross section is proportional to any power of the axial distance. Free-free and free-fixed boundaries are considered.

The first three natural frequencies are given in a set of curves that show the effects of changes in taper (power), fraction of bar which is nonuniform, and truncation. It is shown how the results for torsion can be applied to the analogous problems of one-dimensional longitudinal vibrations in variable-section rods.

A Study of Friction Loss for Spur Gear Teeth..61—WA-85... By Lu N. Tso, Assoc. Mem. ASME, Lieutenant, Chinese Navy; and Roy W. Prowell, Mem. ASME, U. S. Naval Postgraduate School, Monterey, Calif. 1961 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1962).

The power loss associated with the sliding of the tooth profiles on one another is calculated.

The basic consideration in this power loss is the product of the frictional force and the sliding velocity. The frictional force in turn depends upon the normal load applied on the tooth and the coefficient of friction between the teeth. It is related to the contact ratio and to the tooth deflection.

The load distribution, when more than one pair of teeth is in contact, is obtained by considering the deflection of the teeth under load. The equations derived are more general than any found in the literature and the results are compared with existing equations for special cases.

The Dynamic Response of a Nonlinear Hydraulic Damping Device..61—WA-205... By Gale H. Buzzard, II, Assoc. Mem. ASME, Duke University, Durham, N. C. 1961 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1962).

Experimental investigation of the dynamic characteristics of an orifice-type, hydraulic damping device, and a method for analyzing a system employing such a device are described. Although the hydraulic damper has long been used for the dissipation of kinetic energy in mechanical systems, a search of existing literature reveals that very little work has been done in the area of correlating experimental information into useful design data. With this goal in mind, the investigation was pursued.

Lubrication

On the Optimization of the Stiffness of Externally Pressurized Bearings . . 61—Lub-3 . . . By Marvin T. S. Ling, The Cincinnati Milling Machine Company, Cincinnati, Ohio. 1961 ASLE-ASME Lubrication Conference paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to Aug. 1, 1962).

Theoretical studies of the method of optimization of the stiffness of externally pressurized bearings. When an externally pressurized bearing is designed to operate at any given film thickness, it is found that the maximum bearing stiffness can be obtained by proper selection of the value of the ratio of recess to supply pressure, P_r/P_s.

While various values of P_r/P_s can be attained by either varying the restrictor constant for a given film thickness or varying the film thickness for a given restrictor constant, the important quantity to vary in determining the optimum condition is the restrictor constant rather than the film thickness. For an incompressible fluid, the P_r/P_s value for which the bearing stiffness is optimized depends only on the type of compensation used, while for a compressible fluid it is slightly affected by exhaust pressure.

On the Translatory Whirl Motion of a Vertical Rotor in Plain Cylindrical Gas-Dynamic Journal Bearings..61—Lub-4. . . By C. H. T. Pan and B. Sternlicht, Assoc. Mem. ASME, General Electric Company, Schenectady, N. Y. 1961 ASLE-ASME Lubrication Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Aug. 1, 1962).

For the theoretical prediction of the dynamical characteristics of a rotor system, it is necessary to have an accurate knowledge of the bearing fluid film forces under dynamical conditions. With a small clearance ratio and at a moderate speed, the motion of the lubricant is governed by the generalized Reynolds equation. If the lubricant is a gaseous medium, the Reynolds equation is complicated by the compressibility effects, which include nonlinearity and time-dependence under dynamic conditions.

In the case of a vertical rotor operating in plain cylindrical journal bearings, the steady whirl approximation is appropriate and time-dependence in the Reynolds equation can be removed by a co-ordinate transformation. The form of the transformed equation is identical to the static Reynolds equation except that the compressibility number is modified by a factor which depends on the angular speed of the whirl motion. The attitude angle, in the presence of the whirling motion, is quite different from the static attitude angle. On the other hand, the magnitudes of the forces are not very different. The steady whirl analysis may be used to determine the synchronous whirl motion of an unbalanced rotor. The phase angle between the fluid film force and the maximum film thickness plane is the complement of the attitude angle according to the quasi-static analysis.

Experimental data are in excellent agreement with the results of the steady whirl analysis. Also, the modified compressibility number is reduced to zero at half-frequency whirl, and the Reynolds equation, for an isothermal gaseous film with the small eccentricity ratio approximation, becomes identical to that of the liquid film. Since it has been established that the threshold of half-frequency whirl for vertical rotors operating in plain cylindrical journal bearings is at zero speed, the same conclusion applies to the corresponding gas-dynamic bearing.

Analysis of Bearings Operating in Turbulent Regime..61—Lub-5... By V. N. Constantinescu, Institute of Applied Mechanics of the Rumanian Academy, Bucharest, Rumania. 1961 ASLE-ASME Lubrication Conference paper (in type; to published in **Trans. ASME—J. Basic Engng.**; available to Aug. 1, 1962).

The purpose of this paper is to find a solution (even an approximate one) for the following problems: (1) to determine as accurately as possible the transient conditions from the laminar flow to the turbulent one and to estimate the possibility of delaying the occurrence of turbulence, and (2) to determine the operating characteristics of bearings subjected to turbulent lubrication in view of their calculation under such conditions.

Proceeding from the results obtained

previously in the paper "On Turbulent Lubrication" (*Proceedings, I. Mech. E.*, vol. 173, 1959, pp. 881-900 d), this paper analyzes theoretically the three-dimensional motion in the lubricant layer by using Prandtl's mixing length theory. Formulas and diagram are presented for calculating journal and thrust bearings subjected to turbulent lubrication.

The Toroid Contact Roller Test as Applied to the Study of Bearing Materials . . 61—Lub-6 . . . By W. J. Greenert, U. S. Naval Engineering Experiment Station, Annapolis, Md. 1961 ASLE-ASME Lubrication Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Aug. 1, 1962).

An understanding of the basic mechanics and statistical variables of the contact roller test as it is applied to surface fatigue phenomena is obtained. One hundred ninety-four contact rollers of AISI 52100 bearing quality steel were tested to establish dispersion limits.

No significant fatigue differences were indicated for heats, bars, or test replications among steels of similar quality, composition, and heat-treatment. A statistical evaluation of results points to the contact roller test as a suitable means for studying significant variables that pertain to both the theoretical and material aspects of antifriction bearings. Stresses in the contact surfaces based on the orthogonal shear-stress theories show good correlation with fatigue life.

Nonlinear Viscosity Effects in Slider Bearing Lubrication . . 61—Lub-7 . . . By C. W. Ng and Edward Saibel, Mem. ASME, Rensselaer Polytechnic Institute, Troy, N. Y. 1961 ASLE-ASME Lubrication Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Aug. 1, 1962).

The relationship between stress and rate of strain for a non-Newtonian fluid with pseudoplastic behavior is assumed to be a cubic power series. Under this assumption a solution of the slider bearing without side leakage can be obtained using a perturbation technique. The solution turns out to be relatively simple in form in constrast to what results when a general power law is used.

Theoretical Contributions to the Study of Gas-Lubricated Journal Bearings . . 61—Lub-8 . . . By Y. Katto, National Aeronautical Laboratory, Shinkawa, Mitaka, Tokyo, Japan; and S. Soda, University of Tokyo, Komaba, Meguro, Tokyo, Japan. 1961 ASLE-ASME Lubrication Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Aug. 1, 1962).

As a theoretical study of the hydrodynamic, gas-lubricated journal bearings, the paper presents approximate solutions with fair accuracy for high values of eccentricity ratio. In addition, an approximate solution available for clarifying the characteristics of journal bearings operating at low revolution speeds is reported.

Comparison with experimental data reveals the fact that actual bearings operate under an intermediate condition between isothermal and adiabatic when running at high revolution speeds, while under the isothermal condition at low speeds.

Investigation of Whirl in Externally Pressurized Air-Lubricated Journal Bearings . .61—Lub-1. . . By W. A. Gross, Mem. ASME, IBM Research Laboratory, San Jose, Calif. 1961 ASLE-ASME Lubrication Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Aug. 1, 1962).

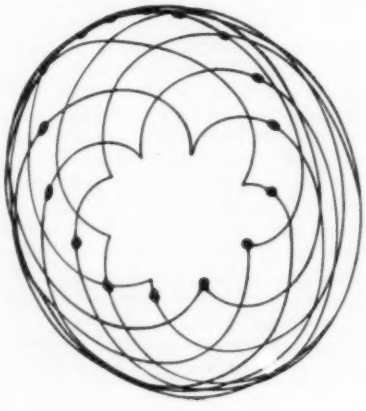
The nature of whirl of a rigid rotor in externally pressurized air-lubricated journal bearings, including self-acting bearings as a special case, is discussed and an experimental investigation described.

Rotor unbalance leads to synchronous whirl, which can persist through one or more critical speeds. Self-excited whirl is likely when the rotational frequency is about twice the lowest critical frequency. Effects of supply pressure, number and location of sources, rotational speed, mass, unbalance, load upon the onset of self-excited whirl, and first-order prediction techniques are discussed.

Counterrotating Journal Bearings . . 61—Lub-9 . . . By O. Pinkus, Mem. ASME, Technical Research Group, Inc., Syosset, N. Y. 1961 ASLE-ASME Lubrication Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Aug. 1, 1962).

A theoretical derivation shows that whenever the center of curvature of a bearing does not coincide with its center of rotation, synchronous counterrotation will produce a load capacity. Test results are given for a number of bearing designs that operated successfully under synchronous counterrotation with load capacities beyond 1500 psi. The only bearing that scored under counterrotation was a perfectly circular ungrooved bearing, as predicted by theory.

Trace of orbiting journal axis showing both synchronous and self-excited whirl components (61—Lub-1)



The Magnetohydrodynamic Slider Bearing . . 61—Lub-10 . . . By William T. Snyder, State University of New York, Long Island Center, Oyster Bay, N. Y. 1961 ASLE-ASME Lubrication Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Aug. 1, 1962).

An analysis is presented of the slider bearing using an electrically conducting lubricant, such as a liquid metal, in the presence of a magnetic field.

The solution permits the calculation of the load-carrying capacity of the bearing. Comparison is made with the classical slider bearing solution. It is shown that the load capacity of the bearing depends on the electromagnetic boundary conditions entering through the conductivity of the bearing surfaces. Numerical data are presented for nonconducting surfaces with the emphasis on a comparison between the classical bearing and the magnetohydrodynamic bearing characteristics. Significant increase in load capacity is possible with liquid metal lubricants in the presence of a magnetic field.

Development of a Ceramic Rolling Contact Bearing for High Temperature Use . . 61—Lub-12. . . By K. M. Taylor, The Carborundum Company, Niagara Falls, N. Y.; L. B. Sibley, Mem. ASME, Battelle Memorial Institute, Columbus, Ohio; and J. C. Lawrence, SKF Industries, Inc., Philadelphia, Pa. 1961 ASLE-ASME Lubrication Conference paper (multilithographed; available to Aug. 1, 1962).

Development of a ceramic ball bearing for use at temperatures of about 1000 to 1500 F is described. Several selected combinations of ceramic and cermet materials were screened in simple sliding and rolling experiments, and the most promising materials were selected for fabrication into full-scale bearings.

Bearing experiments at temperatures of 1000 and 1500 F demonstrated the feasibility of bearing operation at these temperatures with little or no wear under moderate load and speed.

Fluid Lubrication Theory of Roller Bearing; Part I: Fluid Lubrication Theory for Two Rotating Cylinders in Contact . . 61—Lub-13. . . By Tokio Sasaki, Haruo Mori, and Norio Okino, Kyoto University, Kyoto, Japan. 1961 ASLE-ASME Lubrication Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Aug. 1, 1962).

A general and practical fluid lubrication theory is presented of roller bearings

lubricated by Newtonian and non-Newtonian lubricants with considerations to the effect of sliding of roller and the influence of unsteady load.

In Part I, the fundamental theory for the lubrication between two rotating cylinders in contact is investigated. The load capacity and friction of a non-Newtonian lubricant, supposed to be a Bingham plastic, coincide approximately at high speed with those of a Newtonian lubricant with viscosity equivalent to the plastic viscosity of the non-Newtonian lubricant. Under unsteady loads, the squeeze action works effectively so that the load capacity increases. The amount of friction is $^4/_3$ and the load capacity is $^2/_3$ in the case of two rotating cylinders in contact involving sliding, compared with that involving no sliding.

Fluid Lubrication Theory of Roller Bearing; Part II: Fluid Lubrication Theory Applied to Roller Bearing..61—Lub-14... By Tokio Sasaki, Haruo Mori, and Norio Okino, Kyoto University, Kyoto, Japan. 1961 ASLE-ASME Lubrication Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Aug. 1, 1962).

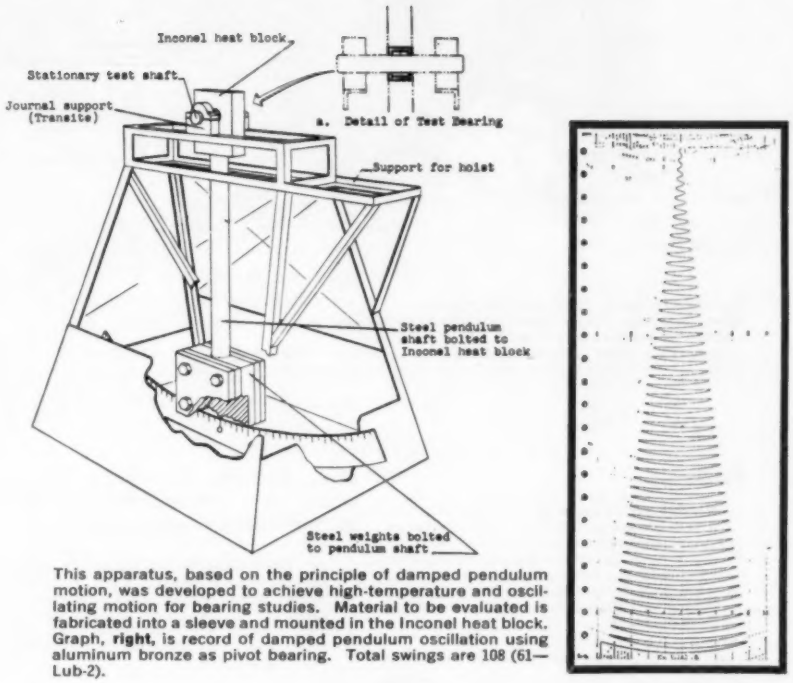
Using the theory for two rotating cylinders in contact obtained in Part I, the fluid lubrication theory of roller bearings for Newtonian and non-Newtonian lubricants was developed with considerations of the influences of unsteady load and sliding of rollers.

It is clarified that the load capacity under unsteady load is generally larger than that under constant basic load and the average friction is nearly equal for both cases. The frictional moment and load capacity for roller bearing, including sliding of rollers, decrease to $^2/_3$ of the amount of those for roller bearing including no sliding.

Experimental Investigation of Oil-Film Behavior in Short Journal Bearings .. 61—Lub-11... By Boris Auksmann, Assoc. Mem. ASME, Ingersoll-Rand Company, Phillipsburg, N. J. 1961 ASLE-ASME Lubrication Conference paper (multilithographed; available to Aug. 1, 1962).

Apparatus designed and built for the experimental investigation of oil-film behavior in short full journal bearings of the circumferential feed-groove type is described. Experimental pressure distributions for the complete bearing are in graphical form for four typical test runs.

Comparison is made with the theoretical solution developed by F. W. Ocvirk for two cases where cavitation in the test bearing was completely suppressed. Agreement with the theory is good for pressurized bearing operated at a low axial pressure gradient. Visual observations of the cavitation phenomena are discussed with references to the photographs.



This apparatus, based on the principle of damped pendulum motion, was developed to achieve high-temperature and oscillating motion for bearing studies. Material to be evaluated is fabricated into a sleeve and mounted in the Inconel heat block. Graph, **right,** is record of damped pendulum oscillation using aluminum bronze as pivot bearing. Total swings are 108 (61—Lub-2).

A Study of High-Temperature Oscillating Plain Bearings . .61—Lub-2 . . . By W. A. Glaeser, Battelle Memorial Institute, Columbus, Ohio. 1961 ASLE-ASME Lubrication Conference paper (multilithographed; available to Aug. 1, 1962).

A heavy pendulum device was used to evaluate lubricants and bearing materials in the development of high-temperature airframe bearings. The method of utilizing this principle for measuring friction coefficients at high temperatures is described. A few materials were found to be outstanding in performance at temperatures as high as 1500 F.

Analysis of the wear surfaces indicate that good performance was associated with the formation of a thin complex oxide layer. The pendulum is found to be an effective means for quickly and inexpensively screening materials and lubricants for high-temperature, heavily loaded, oscillating plain bearings.

Analytical and Experimental Study of Externally Pressurized Air Lubricated Journal Bearings..61—Lub-15... By Jason R. Lemon, The Cincinnati Milling Machine Company, Cincinnati, Ohio. 1961 ASLE-ASME Lubrication Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Aug. 1, 1962).

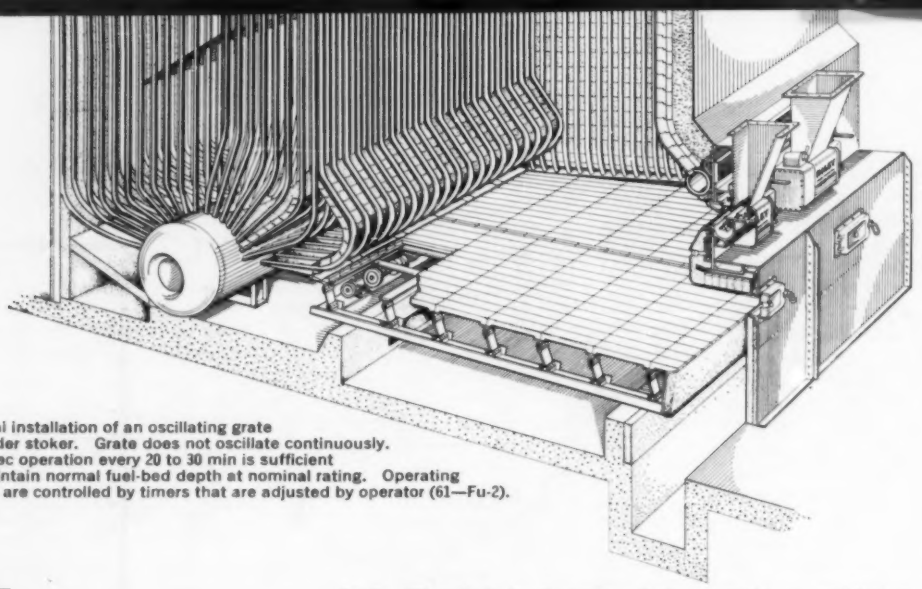
A simplified analysis for calculating the characteristics, such as stiffness, flow, and load of an externally pressurized gas journal bearing, is obtained through a standard one-dimensional flow approach altered to account for the effect of circumferential pressure variations.

It is revealed that bearing stiffness has an optimum which can be chosen through a proper selection of bearing design parameters, such as radial clearance, upstream resistor, and supply pressure.

Solid Lubrication of Metallic Surfaces at Very High Sliding Speeds..61—Lub-16... By T. D. Witherly, Assoc. Mem. ASME, Stanford Research Institute, Menlo Park, Calif. 1961 ASLE-ASME Lubrication Conference paper (multilithographed; available to Aug. 1, 1962).

Rail gripping metal "slippers" are used on supersonic test tracks to provide guidance and restraint for rocket sleds. Excessive slipper wear contributes adversely to the vibrational environment of sleds and catastrophic wear has led to the loss of entire sled systems.

In research on the wear inhibiting capabilities of solid coatings applied to test tracks, four metallic coatings (aluminum, tin-babbitt, lead, and zinc) and two nonmetallic coatings (molybdenum disulfide and calcium hydroxide) were tested in the laboratory at 500 ft/sec rubbing velocity and on the supersonic track at velocities up to 2500 ft/sec. All coatings except lead, when applied to the track surface, reduced wear rates to about one-fifth those values obtaining on bare rail.



Typical installation of an oscillating grate spreader stoker. Grate does not oscillate continuously. A 10-sec operation every 20 to 30 min is sufficient to maintain normal fuel-bed depth at nominal rating. Operating cycles are controlled by timers that are adjusted by operator (61—Fu-2).

Fuels

Electrofrac Techniques..61—Fu-1... By Erich Sarapuu, Mem. ASME, Kewanee Oil Company, Fairfax, Okla.; R. L. Calhoun and John W. Clarke, Electrofrac Corporation, Kansas City, Mo. 1961 ASME-AIME Joint Solid Fuels Conference paper (multilithographed; available to Aug. 1, 1962).

It has been proved possible to create a network of fractures in a hydrocarbon reserve for hundreds of feet by the direct impingement of electrical power.

This is Electrofrac—fractures created along a predetermined distance, at a predetermined location without disturbing the surrounding area—which is the basis of a group of techniques that have recovered the energy from solid hydrocarbons without mining, have been used to increase the production of difficult petroleum reserves, and now are demonstrating their value in related activities.

Steps taken in electrofrac recovery, including electrolinking, electrocarbonization, and electrogasification are defined. Historical development of electrofrac techniques are reviewed along with laboratory and field research.

An Oscillating Grate Spreader Stoker Installation..61—Fu-2... By R. P. Perkins, Assoc. Mem. ASME, E. I. du Pont de Nemours & Company, Wilmington, Del. 1961 ASME-AIME Joint Solid Fuels Conference paper (multilithographed; available to Aug. 1, 1962).

Planning a new powerhouse offered the opportunity for investigating any savings as a result of using an oscillating grate spreader stoker.

The stoker itself consists of a steel frame which is supported on flexure plates arranged to provide a slight downward slope toward the discharge end of the stoker. Welded to the frame are T-members on which the heat-resistance grate bars are supported. The grate bars are held in place by springs extending downward to the bottom of the T-member. An eccentrically weighted shaft is supported from the rear of the frame and causes it to describe an oscillating motion when the shaft is rotated at 1200 rpm.

Installation factors and operating experiences are discussed from both cost and reliability standpoints. The new techniques proved to be reliable and contributed to reduced plant investment and operating costs.

Conditions Required to Burn Fuels Safely in Boiler Furnaces..61—Fu-3... By Ralph M. Hardgrove, Fellow ASME, The Babcock & Wilcox Company, Research Center, Alliance, Ohio. 1961 ASME-AIME Joint Solid Fuels Conference paper (multilithographed; available to Aug. 1, 1962).

The frequency and causes of furnace explosions are reviewed and data on their intensity and the conditions under which they occur are presented.

The need for certain operating instruments and procedures which, if used, should contribute to the safety of burning fuels in boiler furnaces is stressed. Utilization of these procedures in computer control of burner start-up and shutdown is discussed.

Power

Scaling Behavior of Superheater Tube Alloys in ASME High Temperature Steam Research Tests at 1100-1500 F..61—Pwr-3... By F. Eberle and C. H. Anderson, The Babcock & Wilcox Company, Alliance, Ohio. 1961 ASME-AIEE National Power Conference paper (in type; to be published in **Trans. ASME—J. Engng. for Power;** available to July 1, 1962).

Scales formed on seven ferritic and ten austenitic types of commercial tubing presently in use and of potential future use for superheater service were examined after 6, 12, and 18 months' exposure to air and to flowing steam of 2000 psi at temperatures of 1100, 1200, 1350, and 1500 F.

The effect of temperature and time of exposure on the adherence, thermal-shock resistance, thickness, structure, and chemical composition of the scales was investigated and the relative resistance to scaling of the various alloys evaluated.

Results of the scale-thickness measurements, representative photomicrographs of the scale conditions observed on the alloys with the longest exposures, and graphical evaluations and comparisons of the scaling characteristics of the investigated alloys are given.

Save That Turbine—A Starting Technique..61—Pwr-2... By John R. Hamann, Mem. ASME, and Donald C. Parker, Assoc. Mem. ASME, The Detroit Edison Company, Detroit, Mich. 1961 ASME-AIEE National Power Conference paper (multilithographed; available to July 1, 1962).

As power systems grow, older turbines are required to start more frequently. This technique can be used to reduce the temperature shocks caused by historically accepted methods of starting. Photographs of cracked turbine casings and graphs show temperatures within the turbine when old and new starting techniques are used.

Metallurgical Evaluation of Superheater Tube Alloys After 12 and 18 Months' Exposure to Steam at 1200, 1350, and 1500 F..61—Pwr-4... By C. L. Clark, Mem. ASME, The Timken Roller Bearing Company, Canton, Ohio; J. J. B. Rutherford, Mem. ASME, The Babcock & Wilcox Company, Beaver Falls, Pa.; A. B. Wilder, United States Steel Corporation, Pittsburgh, Pa.; and M. A. Cordovi, The International Nickel Company, Inc., New York, N. Y. 1961 ASME-AIEE National Power Conference paper (in type; to be published in **Trans. ASME—J. Engng. for Power;** available to July 1, 1962).

One phase of the program of the ASME Research Committee on High Temperature Steam Generation is to determine the high-temperature strength

and metallurgical stability characteristics of selected alloy tube materials when exposed to the action of steam at temperatures and pressures higher than those to which they are now generally subjected on commercial service. In these tests, the alloys in tubular form are subjected to high pressure steam (2000 psi) at temperatures of 1100 to 1500 F. The tests are to be continued for time periods up to 36 months.

This paper is a continuation of one presented before this Power Conference in 1959. The previous paper presented the metallurgical characteristics, after an exposure time of 6 months, of ferritic materials at 1100 and 1200 F, and of austenitic alloys at 1200, 1350, and 1500 F. This paper considers the following austenitic steels and nickel-base alloys after exposure times of 12 and 18 months: TP 304. TP 316, TP 321, TP 347, TP 310, 16-25-6, 17-14 Cu-Mo, 15-15N, Inconel nickel-chromium, and Incoloy nickel-iron-chromium alloys.

Certain of the results obtained from these same alloys after the six months' exposure test are again included in order to establish more definitely the effect of time on possible changes in the metallurgical characteristics of these materials.

Evaluation of Weldments Joining Superheater Tube Alloys After Exposure to Steam Temperature of 1100–1500 F..61—Pwr-5...By William E. Clautice, U. S. Naval Experiment Station, Annapolis, Md. 1961 ASME-AIEE National Power Conference paper (multilithographed; available to July 1, 1962).

Specimen welds were removed from the ASME High Temperature Steam Generation Committee superheater tube test racks after exposures of 6, 12, and 18 months to 1100–1500 F steam.

The weldments consisted of a wide variety of similar and dissimilar combinations used in assembling the 17 different alloys into the test. Examination showed the welds to be in satisfactory condition. A number of minor defects were found and there were some indications of the slow propagation of fissures with time at temperature.

Spectral Shift Control Reactor..61—Pwr-6 ...By J. Coughlin, The Babcock & Wilcox Company, Lynchburg, Va. 1961 ASME-AIEE National Power Conference paper (multilithographed; available to July 1, 1962).

The spectral shift control concept for nuclear power applications is explained, and its advantages are discussed. Design features of a nuclear steam supply system utilizing an SSCR are described. Performance characteristics, particularly mechanical and thermal aspects, are given.

The Effect of Corrosion by Steam at 1100–1500 F Upon the Heat Transfer Through Superheater Tube Alloys..61—Pwr-1...By H. L. Solberg, Fellow ASME, J. E. Brock, and W. J. Rebello, Purdue University, Lafayette, Ind. 1961 ASME-AIEE National Power Conference paper (in type; to be published in **Trans. ASME—J. Engng. for Power;** available to July 1, 1962).

Heat-transfer tests were made on tubular specimens of ferritic and austenitic types of superheater alloys that had been exposed to high-temperature steam for periods of 6, 12, or 18 months for the purpose of determining the effect of corrosion by steam.

Specimens of scaled tubes, and new tubes of the same alloy, were machined externally to the same dimensions and surfaces, mounted in similar heat exchangers, and tested in series under such conditions that the only difference was in the scaled inner surface of the corroded tube and the bright, smooth, honed inner surface of the clean tube. The heat transfer through ferritic tubes was reduced by as much as fifteen per cent for the temperatures and exposure periods reported upon.

The thin, dense scale on the austenitic alloys increased the heat transfer over that of the clean tube by as much as eight per cent, probably because of the increased roughness of the corroded surface.

Applied Mechanics

On the Application of Variational Methods to Initial Value Problems in Dynamics.. 61—APMW-21...By W. Stuiver, IBM Research Laboratory, San Jose, Calif. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to June 1, 1962).

The variational formulation of the initial value problem is derived and used for the construction of a procedure for the determination of approximate solutions.

As an introduction to the subject the variational approach to the solution of the boundary-value problem is briefly discussed in Section 2. The variational condition associated with the initial value problem is derived in Section 3. The corresponding functional is utilized in Section 4 for the formulation of a variational procedure. This procedure is applied in Section 5, in its most elementary form, to the problem of free periodic motion of simple oscillators. It is shown that for this case the results are identical with those obtained from the conventional variational technique.

Dynamic Stability of a Pendulous Missile Suspension System..61—APMW-22...By V. Chobotov, Assoc. Mem. ASME, Space Technology Laboratories, Inc., Los Angeles, Calif. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to June 1, 1962).

The stability criteria for a missile on a pendulous support are derived for the case of parametrically excited motions of the support. The suspension system is described by two linear, second-order, differential equations with a periodic coefficient. The analysis is carried out by means of the direct method of Liapunov. The results are somewhat modified, however, to obtain greater generality without which the technique is too laborious to be useful.

Wave Propagation in an Elastic Beam or Plate on an Elastic Foundation..61—APMW-25...By J. R. Lloyd and Julius Miklowitz, Mem. ASME, California Institute of Technology, Pasadena, Calif. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to June 1, 1962).

Presented is an analysis of wave propagation in an infinite elastic plate or beam on an elastic foundation, based on a comparison of frequency spectra (or wave-train solutions) from the exact equations and existing approximate bending theories. A distinct similarity is found between the spectrum representing the more exact theory of bending and the Rayleigh-Lamb spectrum for symmetric waves in a free elastic plate, including the existence of complex branches. Good agreement between the approximate theories and the exact equations is found for soft foundations under the usual restrictions of high frequency, short waves.

Transient Thermoelastic Problem for an Infinite Medium With a Spherical Cavity Exhibiting Temperature - Dependent Properties..61—APMW-26... By Jerzy Nowinski, University of Texas, Austin, Texas. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to June 1, 1962).

A polarly symmetric transient thermoelastic problem is investigated for an infinite medium with a spherical cavity, the boundary of the cavity being subjected to a sudden temperature rise.

Thermal and elastic properties of the medium are assumed to be temperature dependent. Using the perturbation method general equations for the displacements and stresses corresponding to particular boundary-value problems have been found. An illustrative example, involving linear variation of conductivity and thermal expansion as well as quadratic variation of shear modulus with temperature, has been discussed.

The Stress Field Produced by Localized Plastic Slip at a Free Surface..61—APMW-27...By T. H. Lin, Mem. ASME, and T. K. Tung, University of California, Los Angeles, Calif. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to June 1, 1962).

Uniform plastic slip is assumed to occur in a cubic region embedded at the free surface of a semi-infinite elastic solid. The slip plane and slip direction are both inclined at 45 deg to the free surface and to two opposite interior faces of the cube. The stress field produced by the slip is the same as that produced by equivalent uniform tractions acting on the faces of the cube.

Closed-form solutions are obtained for all stress components by employing Papkovitch functions to calculate the effects of the equivalent surface tractions. Calculated numerical results for the distribution of stress components are shown graphically. Certain stress components are found to be discontinuous across the boundary surface of the region of plastic slip.

Dynamic Stresses Created by a Moving Crack..61—APMW-28...By B. R. Baker, Lockheed Missiles and Space Division, Sunnyvale, Calif. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to June 1, 1962).

A solution is obtained for the case in which a semi-infinite crack suddenly appears and grows at constant velocity in a stretched elastic body. The problem, one of mixed boundary values on a half plane, is solved by transform methods including the Weiner-Hopf and Cagniard techniques. Among the graphical results presented is the time variation of the transverse stress at a fixed point on the line of fracture as the tip of the crack approaches. Asymptotic forms for the stresses near the crack tip are also obtained and are compared with results of other studies in crack propagation.

Crack-Tip, Stress-Intensity Factors for Plane Extension and Plate Bending Problems..61—APMW-29...By G. C. Sih, P. C. Paris, and F. Erdogan, Lehigh University, Bethlehem, Pa. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to June 1, 1962).

A complex variable method for evaluating the strength of stress singularities at crack tips in plane problems and plate bending problems is derived. The results of these evaluations give Irwin's stress-intensity factors for plane problems and analogous quantities for bending problems, a form familiar to the practitioner of "fracture mechanics." The methods derived are integrated with the complex variable approach of Muskhelishvili to obtain the stress-intensity factors for various basic examples applicable to the extension and bending of plates with through-the-thickness cracks. The results suggest the possibility of extension of the Griffith-Irwin fracture theory to arbitrary plane extensional and/or bending problems in plates.

A Method for Analyzing Axisymmetric Plates With Complicating Conditions..61—APMW-30...By J. E. Brock, Mem. ASME, U. S. Naval Postgraduate School, Monterey, Calif. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to June 1, 1962).

A method is described for the analysis of circular flat plates in which properties may be variable, the elasticity may be othotropic, membrane forces may be significant, and variable temperatures may be involved. It is required, however, that axial symmetry be maintained. Essentially, the method consists in making an assumption (normalized in a certain way) for the principal moment difference, integrating (by analytical or numerical procedures), to find slopes, and then determining the principal moments. From these an improved assumption can be made for the differences, and the process iterated until convergence is satisfactory. Two examples are included.

Slow Viscous Flow Between Rotating Concentric Infinite Cylinders With Axial Roughness..61—WA-5...By S. J. Citron, Purdue University, Lafayette, Ind. 1961 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to Oct. 1, 1962).

The solution is presented to the problem of determining the velocity field and the moment necessary to sustain the motion of a viscous incompressible fluid between two concentric infinite cylinders, rotating with constant but different angular velocities, when the radii of the cylinders vary axially.

The solution is obtained for cases when the equations of slow motion govern the problem. The roughness of each cylinder is assumed small compared to the smooth radius; the roughness need not be small compared to the spacing between the cylinders. Results are explicitly obtained for the case of sinusoidal roughness.

Torsional Vibrations of Shells of Revolution..61—WA-6...By H. Garnet, Assoc. Mem. ASME, M. A. Goldberg, and V. L. Salerno, Mem. ASME, Grumman Aircraft Engineering Corporation, Bethpage, L. I., N. Y. 1961 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to Oct. 1, 1962).

Torsional-vibration modes are uncoupled from the bending and extensional modes in thin shells of revolution. The solution for the uncoupled torsional modes then depends upon a linear second-order differential equation.

The governing equation is subsequently solved for the frequencies of a conical shell. A tabulation of the first five frequencies for varying ratios of the terminal radii is presented. These frequencies are identical to those of an annular plate which has the same support as the conical shell.

On a Restricted Class of Coupled Hill's Equations and Some Applications..61—WA-7...By C. S. Hsu, University of California, Berkeley, Calif. 1961 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to Oct. 1, 1962).

A class of systems of coupled Hill's equations is studied. It is shown that for systems of equations in this class, completely decoupled Hill's equations may be obtained and the stability of the solutions may be studied in a much simpler manner. Several physically significant problems are treated to demonstrate the nature of the method.

The Rolling Contact of a Rigid Cylinder With a Viscoelastic Half Space..61—WA-8...By S. C. Hunter, Brown University, Providence, R. I., and Stanford University, Stanford, Calif. 1961 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to Oct. 1, 1962).

The problem of a rigid cylinder rolling on the surface of a viscoelastic solid is solved in an approximation in which inertial forces are neglected.

With the introduction of viscoelastic effects, the symmetry associated with the corresponding elastic problem is destroyed, and in particular the cylinder motion is impeded by a resistive force. For a standard linear solid, the resulting coefficient of friction, a function of the rolling velocity V, tends to zero for small and large values of V, and attains a single maximum at an intermediate value.

Irreversible Thermodynamics of the Thermal Characteristics of Porous Insulators..61—WA-9...By R. G. Mokadam, Indian Institute of Technology, Kharagpur, S. E. Ry., India. 1961 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to Oct. 1, 1962).

The entropy equation contains terms which indicate entropy generation due to two irreversible processes: Heat flow in the presence of temperature gradient and gas flow in the presence of frictional force. These flows are assumed to be linearly dependent upon the temperature gradient and the frictional force.

This assumption includes two cross phenomena: Convective heat transfer

(set up by pressure gradient) and free convection (set up by temperature gradient). They are interdependent. Usually the frictional force is equal to the gaseous-phase pressure gradient.

When this pressure gradient is zero, the heat flow depends only upon the thermal gradient. By entrapping the gas in the porous medium, the gas flow is stopped. This gives rise to a pressure gradient which sets up a convective heat flow opposing that due to thermal gradient. Consequently, the thermal conductivity of the porous insulator decreases. Experimental work on Tritex insulation material indicated a 22 per cent decrease in thermal conductivity.

Physical Interpretation of Fictitious Nodes Encountered in the Node Method of Vibration Analysis..61—WA-4... By G. C. Best, Fort Worth, Texas. 1961 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to Oct. 1, 1962).

When performing a vibration analysis of a structure by the node method the system of equations which define the locations of the nodes may have more than one set of solutions. Some solutions will give the node locations by an obvious interpretation. Others might be called "fictitious." For example, in the problem presented the node locations are determined from a parameter μ and the negative value of μ related to the first vibration mode of the system can be interpreted as a fictitious node with a positive and a negative spring added to the system. A method of interpreting apparently meaningless solutions of the system of equations encountered when solving a vibration problem by the node method is presented. These solutions are associated with fictitious nodes connected to the structure by a device called a structural doublet. An illustrative problem is solved.

Application of Moire Methods to the Determination of Transient Stress and Strain Distributions..61—WA-10... By W. F. Riley and A. J. Durelli, Assoc. Mem. ASME, Illinois Institute of Technology, Chicago, Ill. 1961 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to Oct. 1, 1962).

When two arrays of lines are superimposed, an optical phenomenon known as the moire effect is observed under certain conditions. This moire effect is used by the authors to determine the distribution of transient strains on the surface of two-dimensional bodies.

The method can be used to solve completely the strain-distribution problem or it can be used in combination with photoelasticity to separate the principal stresses. The methods used in interpreting the moire fringe patterns and the techniques used to produce the patterns are described. Two applications are discussed.

On Vibrations of Pretwisted Rectangular Plates..61—WA-23... By R. P. Nordgren, University of California, Berkeley, Calif. 1961 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to Oct. 1, 1962).

An analysis is made of the free vibrations of uniformly pretwisted rectangular plates, utilizing the exact equations of classical shallow-shell theory.

Specifically, solutions are given (*a*) for two opposite edges simply supported and the other two free, and (*b*) for all four edges simply supported. Numerical results obtained for case (*b*) are compared with previous results for the torsional vibrations of pretwisted beams. A simple frequency equation is obtained for case (*b*) permitting a detailed study of the effects of both pretwist and longitudinal inertia.

The Axially Loaded Circular Cylinder..61—WA-24... By H. D. Conway, Cornell University, Ithaca, N. Y. 1961 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to Oct. 1, 1962).

Commencing with Kelvin's closed-form solution to the problem of a concentrated force acting at a given point in an indefinitely extended solid, a Fourier transform method is used to obtain an exact solution for the case when the force acts along the axis of a circular cylinder.

Numerical values are obtained for the maximum direct stress on cross sections at various distances from the force. These are then compared with the corresponding stresses from the solution for an infinitely long strip. In both cases it is observed that the stresses are practically uniform on cross sections greater than a diameter or width from the point of application of the load.

Stability of Two Planar Loop Elastics..61—WA-11... By E. E. Zajac, Assoc. Mem. ASME, Bell Telephone Laboratories, Inc., Murray Hill, N. J. 1961 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to Oct. 1, 1962).

The formation of loops and kinks in cable is a long-standing problem in the submarine-cable art. Cable which has been recovered from deep seas is often twisted so that it is difficult to coil and store in cable tanks. Likewise, during the recovery process kinks are often formed which make the cable useless.

Two specific problems related to the formation of loops and kinks, (*a*) a twisted circular hoop and (*b*) the classical noninflectional plane elastica, are considered.

Both involve the stability of plane, or essentially plane configurations of cable, and are attacked by means of the Kirchhoff theory of thin elastic rods. A typical telephone cable is of course far removed from a perfectly elastic rod, and the results obtained are mainly qualitative.

However, the results do give valuable insights into the behavior of actual cable. Furthermore, it is felt that they are of intrinsic interest in applied mechanics.

Torsional Creep Buckling of Thin-Walled Open Tubes With a Cross Section Having an Axis of Symmetry..61—WA-14... By George Lianis, Purdue University, Lafayette, Ind. 1961 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to Oct. 1, 1962).

The variational theorem by Sanders, McComb, and Schlechte is applied to find the critical collapse time of an open thin-walled tube with a cross section having an axis of symmetry subjected to torsional creep buckling. Large deformation strains are considered.

It is shown that small deformation strains yield inaccurate results in predicting the critical time. A simplified stress distribution is introduced that gives a closed-form solution. More accurate stress patterns present considerable difficulties and a tedious numerical integration is needed. In examining most cases, however, the simplified stress configuration predicts the critical time very accurately.

The Elastic Moduli of Heterogeneous Materials..61—WA-39... By Zvi Hashin, University of Pennsylvania, Philadelphia, Pa. 1961 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl Mech.**; available to Oct. 1, 1962).

Bounds and expressions for the elastic moduli of two or many phase nonhomogeneous materials are obtained by an approximate method based on the variational theorems of the theory of elasticity and on a concentric-spheres model. Theoretical results are in good agreement with experimental results for a two-phase alloy.

On Vibrations of Elastic Spherical Shells..61—WA-42... By P. M. Naghdi, Mem. ASME, University of California, Berkeley, Calif.; and A. Kalnins, Assoc. Mem. ASME, Yale University, New Haven, Conn. 1961 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to Oct. 1, 1962).

Axisymmetric and asymmetric vibrations of thin elastic spherical shells are investigated. First, with the limitation to torsionless axisymmetric motion, the basic equations for spherical shells of the classical bending theory of Love's

first approximation are reduced to a system of two coupled differential equations in normal displacement of the middle surface and a stress function. This system of equations is applied to free vibrations of a hemispherical shell with a free edge, and numerical results are obtained for the lowest natural frequency as a function of the thickness of the shell.

The remainder of the paper is mainly devoted to a study of asymmetric vibrations of a hemispherical shell with a free edge according to the extensional theory. Numerical results for natural frequencies (of the four lowest circumferential wave numbers) and mode shapes are given, and the results are compared with the prediction of Rayleigh's inextensional theory.

Transient Compressional Waves in an Infinite Elastic Plate or Elastic Layer Overlying a Rigid Half-Space..61—WA-21... By Julius Miklowitz, Mem. ASME, California Institute of Technology, Pasadena, Calif. 1961 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to Oct. 1, 1962).

The problem treated is that of an infinite free plate excited symmetrically by two equal and normally opposed step point-loads on its faces. The problem is equivalent to that of the surface normal point-load excitation of an infinite elastic layer, half the thickness of the plate, overlying a rigid half-space with lubricated contact.

The formal solution is obtained from the equations of motion in linear elasticity with the aid of a double integral transform technique and residue theory. The stationary phase method, and known characteristics of the governing Rayleigh-Lamb frequency equation, are used to analyze and evaluate numerically the far field displacements. It is shown that the head of the disturbance is composed predominantly of the low frequency-long waves from the lowest mode of wave transmission.

Strongest Columns and Isoperimetric Inequalities for Eigenvalues..61—WA-20... By I. Tadjbakhsh and J. B. Keller, New York University, New York, N. Y. 1961 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to Oct. 1, 1962).

The problem of determining what shape column has the largest critical buckling load of all columns of given length and volume is considered. This problem was previously solved for a column hinged (pinned) at both ends. It is solved for columns clamped at one end and clamped, hinged, or free at the other end, assuming that all cross sections of the column are similar.

It is proved that the column previously obtained in the hinged-hinged case is actually strongest and not merely stationary. Graphs of the areas of the strongest columns as functions of distance along the columns are given.

Transient Analysis of Shear Impact..61—WA-15... By Andrew Pytel and Norman Davids, The Pennsylvania State University, University Park, Pa. 1961 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to Oct. 1, 1962).

A transient analysis is made of the propagation of stress waves generated by time-dependent tangential surface loadings. The problem is solved by representing the concentrated load as a delta-function singularity and applying the boundary conditions to the general solutions of motion.

Expansion in a power series leads to terms that represent successively reflected waves. The complete expressions for the axial shearing stress and axial displacement for an arbitrary forcing function are obtained and curves are shown for step and exponential pulse inputs for an aluminum plate.

Process Industries

Predicting Process Gas Performance of Centrifugal Compressors From Air Test Data . . 61—PID-1 . . . By Philip P. O'Neill and Herbert E. Wickli, E. I. du Pont de Nemours & Company, Inc., Wilmington, Del. 1961 ASME Process Industries Conference paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to Aug. 1, 1962).

Problems associated with performing tests at the manufacturer's plant under process conditions and the lack of a universally accepted method of performance correlation are matters of concern.

A recommended correlation procedure evolved from the review of technical papers on aspects of the subject is presented. A program for the free interchange of air and process test data between manufacturer and user that (*a*) provides designers with essential information previously unavailable to them, and (*b*) ultimately benefits the user by the production of higher-performance machines, is submitted.

Application of a Centrifugal Compressor to a Complex Gas Mixture . . 61—PID-2 . . . By William Pechenick, Catalytic Construction Company, Philadelphia, Pa. 1961 ASME Process Industries Conference paper (multilithographed; available to Aug. 1, 1962).

Application of a centrifugal compressor to a particularly difficult compression problem in the chemical industry is described, as well as the reason for choosing a centrifugal compressor, the manner of overcoming anticipated corrosion problems, and the process considerations to permit the compressor to operate satisfactorily over a wide range of capacity during start-up and operation.

The First Municipal Sea Water Conversion Plant in the U. S. . . 61—PID-4 . . . By Allen Cywin, Mem. ASME, R. H. Jebens, G. D. Dodd, Mem. ASME, H. D. Singleton, U. S. Department of the Interior, Office of Saline Water, Washington, D. C. 1961 ASME Process Industries Conference paper (multilithographed; available to Aug. 1, 1962).

The Office of Saline Water is constructing five different saline-water-conversion demonstration plants. The first plant, located at Freeport, Tex., was placed on stream within twelve months of start of construction. It is the first of its type, the largest sea-water conversion plant in the United States, and the most efficient ever constructed. It is now furnishing high quality potable and industrial water at a rate of 1,000,000 gal per day.

A rigid cost system has been established to record all incurred expense for the plant's operation.

J. E. Sunderland and R. J. Grosh. (60—WA-277)

Heat Transfer to Longitudinal Laminar Flow Between Cylinders, by E. M. Sparrow, A. L. Loeffler, Jr., and H. A. Hubbard. (60—WA-40)

Unsteady Laminar Flow in a Duct With Unsteady Heat Addition, by Morris Perlmutter and Robert Siegel. (60—WA-174)

Fully Developed Pressure Drop in Triangular Shaped Ducts, by L. W. Carlson and T. F. Irvine, Jr. (60—WA-100)

The Effect of a Longitudinal Magnetic Field on Pipe Flow of Mercury, by Samuel Globe. (60—WA-192)

An Exact Solution of the Compressible-Flow Characteristics in Constant-Area Passages With Simultaneous Friction and Constant Heat Flux, by R. N. Noyes. (60—WA-177)

Experimental Ablation Rates in a Turbulent Boundary Layer, by E. P. Bartlett and M. R. Denison. (60—WA-208)

On Some Laminar Forced-Convection Problems, by L. N. Tao. (60—WA-188)

Unsteady Laminar Free Convection, by P. M. Chung and A. D. Anderson. (60—WA-211)

Buoyancy Effects in Forced Laminar Convection Flow Over a Horizontal Flat Plate, by Yasuo Mori. (60—WA-220)

Local Mass Transfer From Circular Cylinders in Cross Flow, by H. H. Sogin and V. S. Subramanian. (60—WA-193)

Radiant Interchange Between Circular Disks Having Arbitrarily Different Temperatures, by E. M. Sparrow and J. L. Gregg. (60—WA-75)

Axial Temperature Distribution for a Nuclear Reactor With Sinusoidal Space and Exponential Time-Varying Power Generation, by W. O. Doggett and E. L. Arnold. (60—WA-194)

Technical Briefs

Two-Phase Frictional Pressure Drop-Prediction From Levy's Momentum Model, by J. F. Marchaterre.

Transient Temperature Measurement Errors in Heated Slabs for Thermocouples Located at the Insulated Surface, by D. R. Burnett.

Heat Conduction in a Series Composite Wall, by J. J. Brogan and P. J. Schneider.

Heat Conduction Through Walls During Fire, by Lie Tiam Tjoan.

Heat Conduction in an Eccentrically Hollow, Infinitely Long Cylinder With Internal Heat Generation, by M. R. El-Saden.

On Some Analytic Solutions of Steady Heat Conduction in Composite Slabs of Various Cross Sections, by Pau-Chang Lu.

Tables of Cosh $(1 + i)X$, Sinh $(1 + i)X/(1 + i)X$, and $(1 + i)X$ Sinh $(1 + i)X$ for Periodic Heat Conduction Calculations, by D. G. Stephenson and C. J. Shirtliffe.

Mass Transfer in Laminar Flow About a Rotating Cone, by C. L. Tien.

Improved Computer Oriented Methods for Calculation of Steam Properties, by T. W. Martin.

Comparison of the Implicit and Explicit Methods for Finite Difference Heat-Transfer Calculations, by J. T. Anderson, J. M. Boyle, and W. K. Koffel.

ASME Order Forms

Technical Papers

Pamphlet copies of numbered ASME technical papers are obtainable from the ASME Order Department, United Engineering Center, 345 East 47th Street, New York 17, N. Y. **Please order only by paper number**; otherwise orders will be returned. Papers are priced at 50 cents to members of ASME; $1 to nonmembers, plus postage and handling charges. You can save postage and handling charges by including your check or money order made payable to ASME and sending it with your order to ASME Order Department, United Engineering Center, 345 East 47th Street, New York 17, N. Y. Payment also may be made by free coupons, or coupons purchased from the Society in lots of ten at $4 to members; $8 to nonmembers.

Note: No digests are made of ASME papers published in full or condensed form in MECHANICAL ENGINEERING.

Copies of all ASME publications are on file in the Engineering Societies Library and are indexed by the Engineering Index, Inc., both of United Engineering Center, 345 East 47th Street, New York 17, N. Y.

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Notes on Books Received in Engineering Societies Library

REVIEWS OF BOOKS

Blooming and Slabbing Mills

Experimental Analysis of Modern Blooming and Slabbing Mills. (Retriebsuntersuchungen an neuzeitlichen Block-Brammen-Strassen). 71 p., 8¼ × 11¾ in., illus. Section 1 (mechanical) by Muller and Lueg; Section 2 (electrical) by Nurnberg. Published by Stahleisen, 1960, in the series, "Stahleisen Sonderberichte," Heft 1. Bound, 16 DM (about $4).

THIS thin book should be of extreme interest to builders and operators of heavy rolling mills and to electrical concerns that make the drives. After a brief review of the theory of hot rolling thick sections, the authors give the measured quantities which were obtained by the use of 20 oscillographs. The measurements present not only individual values for each of the four tested mills, but also mean values that were averaged for each pass of the four mills. Data are given on roll pressure, separating force, torque, distribution of load on the bearings, bearing friction, time in pass, time on roller table, acceleration, distribution of torque on the spindles, vibration in spindles, motor efficiency, control of speed of main motors and of screw-down motors, method of producing direct current, and still other important features. The book takes all the guesswork out of blooming and slabbing mills and out of the electric equipment.

The word "modern" in the title of the book is not quite correct, because truly modern reversing mills are driven by four electric motors for the purpose of making the mills reverse as quickly as the engine-driven mills.

The authors and the test staff are to be congratulated on the results of their painstaking efforts.

The reviewer wishes that the mechanical part of the information might have been available 60 years ago, when he designed blooming mills and engines for operating them.—*W. Trinks.*[1]

Iron and Steel

Eisenhütte, a handbook for engineers and operators in the iron and steel industry. Published by Wilhelm Ernst & Sohn, Berlin, Germany, 1961. Fifth Edition, 1342 p., 5½ × 8¼ in., illus, and tables. Bound. 98 DM (about $24.50).

THIS volume is one of the famous handbooks compiled by Hütte, an academic society in Germany. Thirty years have elapsed since publication of the fourth edition. The book is entirely new and is the work of more than 80 coauthors. It covers theory and practice of the industry from the raw materials to the final product made by rolling, forging, extrusion, and by coating. Statistics on raw materials are international. For each process, the equipment is described and well illustrated. The method of operation is explained. The metallurgy of ferrous materials and alloys is discussed in detail. Many cost data are given. Foundry practice, including centrifugal casting, also is discussed in detail. Even small-tonnage processes such as pipe couplings and the weaving of wire fences are explained and illustrated. Hourly capacities for each process are given. Each section is followed by a bibliography. The book is up-to-date as of 1958. It takes two and a half to three years to publish a manuscript.—*W. Trinks.*[1]

Chemical Gas Analysis

Chemical Gas Analysis (Chemische Gas-Analyse). 131 p., 5½ × 8¼ in., illus, tables. Issued by the Heat-Economy Section of the German Iron and Steel Institute, published, 1960, by Verlag Stahleisen, Dusseldorf, Germany. Bound, 9.80 DM (about $2).

THIS informative manual was written for the use of combustion technicians in the iron and steel plants who analyze products of combustion and fuel gases. The manual starts with methods and apparatus for taking samples and then gives a detailed description of the Orsat apparatus as well as directions for using it in searching for CO_2, O_2, and CO. The chemistry of the sealing fluids and of the gas-absorbing fluids is given in great detail. The preparation of the absorbents is given. The book contains explicit instructions for operating the three-pipette and the five-pipette analyzers. The effectiveness of the absorbent fluids is discussed. Then follow methods and apparatus for measuring hydrogen, methane, and heavy hydrocarbons.

The physical and chemical laws that must be known for evaluating the measurements are given, and so are numerous examples for calculating the composition of a gas from the measured values. Every step from taking the sample to the final result is explained and illustrated in great details. At every step, easily made mistakes and oversights are pointed out and their effects on falsifying the final result are evaluated.—*W. Trinks.*[1]

[1] Professor-emeritus, Carnegie Institute of Technology, Pittsburgh, Pa. Fellow ASME.

BOOKS RECEIVED IN LIBRARY

Materials for Nuclear Engineers
Edited by A. B. McIntosh and T. J. Heal. 1960, Interscience Publishers, Inc., New York, N. Y. 373 p., 5½ × 8¾ in., bound. $11.85. The introductory chapter discusses the use by nuclear engineers of data on the properties of materials. Succeeding chapters concentrate on the behavior and properties of uranium, thorium, plutonium, ceramic fuels, graphite, magnesium, beryllium, and zirconium.

Mathematical Handbook for Scientists and Engineers
By Granino A. Korn and Theresa M. Korn. 1961, McGraw-Hill Book Company, Inc., New York, N. Y. 943 p., 6¼ × 9¼ in., bound. $20. This is a comprehensive reference collection of mathematical definitions, theorems, and formulas for scientists, engineers, and students, including both undergraduate and graduate-level material.

Metals Handbook, Vol. 1: Properties and Selection of Metals.
8th Edition. 1961, American Society for Metals, Metals Park, Novelty, Ohio. 1300 p., 8½ × 11¼ in., bound. $30. This is the first of a series of volumes which will supersede and expand the single-volume 7th edition (1948). Its purpose is to present significant data on the properties of metals, and to provide criteria which will assist in the selection of the most suitable metals for specific purposes. Authorship has been expanded to include more engineers from more industries: 83 committees and more than 1300 individuals are named as contributors.

Current Engineering: Events, News, and Comment

E. S. NEWMAN
News Editor

THE ROUNDUP

Engineering Section Established Within NSF

IMPETUS will be given to basic research in engineering through establishment of an Engineering Section within the National Science Foundation. The new Section, which replaces the Engineering Sciences Program office, will encompass a wide variety of programs in engineering research.

"Over-all approach of the Section will be to encourage research leading to rational methods for bringing all the resources of science to bear on the problems of our technological civilization," said Dr. Alan T. Waterman, Foundation Director, in announcing establishment of the Section. "Programs to be established within the Section will take into account the social, psychological, and biological sciences on which much present-day engineering must be based, as well as the physical and mathematical sciences."

The new Section will consider proposals for basic research in all fields of engineering. In addition to the fundamental engineering sciences such as theoretical and applied mechanics, basic research areas such as those involving design and systems engineering will be supported. Special encouragement will be given in basic areas of national need, for example, fire research and transportation.

Dr. Samuel Seely, on leave from Case Institute of Technology where he is professor of electrical engineering, heads the new Section. He is the author of seven books, with an eighth in press.

Typical research areas that will be supported in engineering schools throughout the country include the following:

Materials, including solid-state science, metallurgy, inorganic and organic materials.

Thermodynamics, heat transfer, mass transfer, and chemical kinetics and mechanisms.

Mechanics of fluids, solids, and aggregates.

Electron and ion beams, plasmas, energy conversion, and electromagnetics.

Information processing, signal and information theory, control theory, and operations research.

In addition to basic research in engineering the Section will support conferences, symposiums, and foreign travel for engineering research purposes.

Since 1956, Dr. Seely has been with Case Institute. Prior to that time he was at Syracuse University as chairman of the electrical-engineering department. He worked with the office of Scientific Research and Development during World War II; with the R & D Board of the Department of Defense in 1950; and as a consultant to the Chief Signal Officer, U. S. Army, in 1952–1953.

200 Attend ECPD Annual Meeting in Louisville, Ky.

THE Engineers' Council for Professional Development held its twenty-ninth annual meeting at Louisville, Ky., Oct. 2–3, 1961. One of the largest groups, more than 200 persons who had come from all sectors of the United States as well as from Canada, ever to attend participated in activities.

Meetings of Standing Committees including Guidance, Student Development, Development of Young Engineers, Recognition, Ethics, and Information were held on October 2. The Education and Accreditation Committee had already convened in closed sessions for two days to consider reports of the evaluation of hundreds of curriculums inspected during the previous 12 months. Later that day the Executive Committee met to consider pertinent business and to elect new officers for the year 1961–1962.

New Officers. Ralph A. Morgen, dean of the Graduate School at Stevens Institute of Technology, Hoboken, N. J., was chosen president to succeed Dean W. L. Everitt of the University of Illinois who was completing his third year in that office.

President's Report. At the annual banquet, Monday evening, Dean Everitt presented a report of ECPD accomplishments in 1960–1961 and of his conception of those matters which ECPD must seek to accomplish in the near future. Items of general interest from the President's report include:

Mechanical-engineering curriculums were newly accredited at Trinity College, Hartford, Conn.; Lamar College of Technology, Beaumont Texas; University of Wichita, Kansas; Arizona State University at Tempe; and at the Utah State University.

The ECPD Council acted to request the American Society for Engineering Education to initiate another evaluation of engineering education.

Another action of Council was to approve the idea of a World Conference on Engineering Education in 1964, in New York City, during the World's Fair. Implementation of the proposal will be in the hands of Executive Committee.

Annual Banquet. Mark Ethridge, principal banquet speaker and publisher of the *Courier Journal* and *Louisville Times*, spoke on the topic "Problems of the Near

East," a subject of intimate knowledge to him since he has served the Federal Government on several occasions in the capacity of specialist in Near East affairs.

A panel discussion directed to the theme "Where Does Professional Specialization Belong in the Engineering Curricula?" was held on the second day of the convention. LeVan Griffis, dean of engineering at Rice University, approached the subject in its relation to the undergraduate curriculums, and Dean L. E. Grinter of the Graduate School of the University of Florida presented his views regarding the significance of this topic as it relates to graduate study. The effects of professional specialization on accreditation principles and procedures were considered by William K. Selden, Executive Secretary of the National Committee on Accrediting, and the formal presentations were concluded with a consideration of the panel topic in relation to industry needs by Lloyd E. Elkins, Production Research Director of Pan American Petroleum Corporation.

The final event on the program consisted of two reviews of reports concerning engineering education. Associate Dean of Engineering, Cornelius Wandmacher, University of Cincinnati, commented about the conference held at the University of Michigan in June, 1960, sponsored by the National Science Foundation, to consider what should be included in future educational programs of civil-engineering students. Then Thorndike Saville, dean-emeritus of the College of Engineering of New York University, presented a résumé of a report on engineering education in Western Europe. This report, soon to be published by ECPD, has been prepared through the EUSEC organization (Engineering Societies of Western Europe and The United States of America).

With the close of this meeting, ECPD launched its thirtieth year of existence as a federation of engineering societies—to continue as a most potent force in the realm of engineering education. It is significant to note that in addition to the eight constituent bodies two other societies were admitted to membership in ECPD during 1961. These are The Institute of Radio Engineers and the Institute of the Aerospace Sciences. With these ten member bodies banded together, there is reason to expect even greater accomplishments in the years ahead for ECPD.

Annual Report. The 29th annual report of ECPD is now available at $1 a copy. Requests for copies should be addressed to ECPD, United Engineering Center, 345 East 47th Street, New York 17, N. Y.

PEOPLE

Honors and Awards. Detlev W. Bronk, Hon. Mem. ASME, president of the Rockefeller Institute, received the Franklin Medal on October 18 for his medical research and scientific leadership. On November 3, Dr. Bronk received the gold medal of the Holland Society during its 77th annual dinner. The society is composed of descendants in the male line of residents in the Dutch colonies is America before 1675.

Ali Bulent Cambel, Mem. ASME has been named a Walter P. Murphy Distinguished Professor. Dr. Cambel, who is professor of mechanical engineering at Northwestern University, is also director of Northwestern's Gas Dynamics Laboratory and founder of the biennial Gas Dynamics Symposium held at Northwestern.

William T. Field, Mem. ASME, has been made an honorary member of the St. Lawrence Seaway Pioneers, a new organization whose members fought for the realization of the St. Lawrence Seaway before 1954, when it was not as popular as it is now. Mr. Field, a consulting engineer, was an early advocate of the power project.

The Hon. John P. Morrissey, Mem. ASME, State Senator of the 22nd District, received the Award to Distinguished Engineer in Public Service at the annual awards dinner of the New York Chapter of the New York State Society of Professional Engineers on October 19.

Theodore J. Kauffeld, Mem. ASME, New York consulting engineer, received the Award to Distinguished Engineer in Industry during the dinner, which was held at the Statler Hilton Hotel in New York City.

Charles H. Townes, who was recently named Provost of Massachusetts Institute of Technology, received the David Sarnoff Award for the research in resonance physics leading to major advances in communication technology. Dr. Townes was the first to predict from theory the feasibility of the "maser" or microwave amplification by means of stimulated radiation. He received the honor on October 16 at the opening of the Fall General Meeting of the American Institute of Electrical Engineers at the Statler-Hilton Hotel, Detroit, Mich.

Theodore A. Rich, consulting engineer, General Electric Company, Schenectady, N. Y., received the Morris E. Lee Award during the AIEE meeting for contributions to the field of measurement.

Mervin J. Kelly, former chairman of

Wesley L. Orr, Mem. ASME, of UCLA confers here with Professor Winoto, his associate in the engineering department at Gadjah Mada University in Jogjakarta, Indonesia. Professor Orr went to Indonesia in August, 1957, as one of the American professors sent by UCLA to help develop and strengthen the curriculum and facilities at Gadjah Mada under the program of the International Co-operation Administration. Professor Orr is team leader and assistant dean of UCLA's engineering department. He recently returned, with Mrs. Orr, to the United States, where he resumed his position on the faculty.

the board of Bell Telephone Laboratories, Inc., received the 1961 Hoover Medal for distinguished public service during the dedication of the United Engineering Center at 345 E. 47th Street, on November 9. The medal was presented in person by former President HERBERT HOOVER, Hon Mem. ASME, for whom it is named.

The Magazine of Standards, under direction of its editor, RUTH E. MASON, was cited for outstanding contribution to the literature on standards in a joint SES-ASTM award. The magazine is published by the American Standards Association.

Special service citation for outstanding service to the Standards Engineers Society was presented to ANTOINE F. GAGNE, Mem. ASME, who has given generously of his time and talents and has contributed to the growth and development of the society.

CRAWFORD H. GREENEWALT, president of E. I. du Pont de Nemours & Company, will be the 1962 recipient of the John Fritz Medal.

MRS. PEARL CLARK, noted management consultant and author, was awarded Honorary Membership in the Society of Women Engineers at the society's dedication banquet November 8. DR. L. M. GILBRETH, Hon. Mem. ASME, was the principal speaker. Her topic was "The Daughters of Martha."

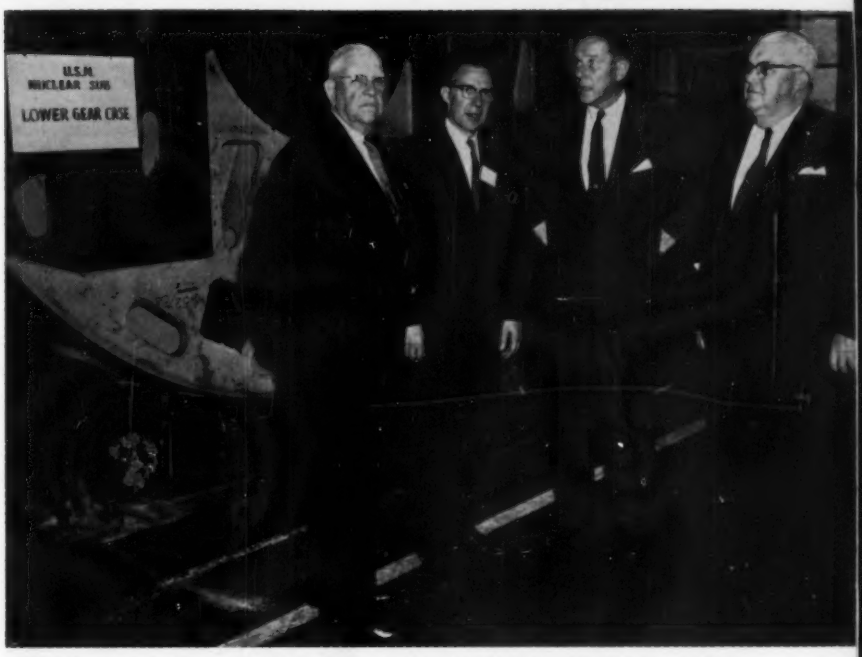
M. HENRY TOULOUSE, chairman of the Board of PARIDOC, a group of European chain stores with headquarters in Paris, France, will receive the 1962 Wallace Clark Award for his achievements in promoting the management movement in France.

New Officers. LESLIE S. WILCOXSON, Fellow ASME, vice-president of the Boiler Division, Babcock & Wilcox Company, has been elected chairman of the Welding Research Council-Engineering Foundation for a three-year period. He has been vice-chairman of the council for the past three years.

JOHN V. GRIMALDI, Mem. ASME, was elected president of the American Society of Safety Engineers at the society's annual meeting on October 16 in the Conrad Hilton Hotel, Chicago, Ill. Mr. Grimaldi is consultant, safety and plant protection, General Electric Company, New York, N. Y.

JAMES R. LAMPMAN, manager of the General Electric Company's Organic Chemical Engineering Materials and Process Laboratory, Syracuse, N. Y., is the new president for 1962 of the Society of Plastics Engineers.

ALLEN F. RHODES, Mem. ASME, chairman, ASME Petroleum Division, has been named president of the McEvoy



A plant tour was a feature of the 60th anniversary celebration of the founding of De Laval Steam Turbine Company held during the week of October 2. Among those taking the tour was ASME President W. H. Byrne, **right,** who was a guest of the company and the representative of the professional engineering societies. Also present were, from **left,** C. Richard Waller, Fellow ASME, consulting engineer and former director of engineering at De Laval, and Charles A. Jurgensen, Mem. ASME, vice-president at De Laval. The three men listen to Charles L. Huston, Jr., president of Lukens Steel Company, as he explains a large gear case weldment fabricated by Lukens for use on one of the new nuclear submarines.

Marlene Schmidt, **right,** of West Germany, Miss Universe of 1961, receives a membership certificate of the Society of Women Engineers from Patricia L. Brown, national president of the society. Miss Schmidt, who is an engineer with I. G. Eckhardt, AG, Stuttgart, West Germany, designs and tests electronic indicating instruments. She was the special guest of the society at its Eastern Seaboard Conference in Pittsburgh, Pa., on October 21–22. Miss Brown is supervisor of information services, Texas Instruments, Dallas, Texas.

Norman Zlatin, **left,** Mem. ASME, and John F. Kahles, vice-presidents of Metcut Research Associates, Inc., Cincinnati, Ohio, have been selected by the International Co-operation Administration to provide technical assistance for the metals industry in Israel during the next seven months. Dr. Kahles will serve from October to January, 1962, and Mr. Zlatin from January through May.

Company, subsidiary of the Houston Corporation, Houston, Texas.

Campus Data. RALPH A. MORGEN, dean of the Graduate School at Stevens Institute of Technology, is the new president of the Engineers' Council for Professional Development.

Patents. VANNEVAR BUSH, Hon. Mem. ASME, has been granted a patent for an improved free-piston engine being developed by the Stewart-Warner Corporation, Springfield, Ill. Dr. Bush expects his engine to be adopted first for stationary use and later for motor vehicles. Dr. Bush is honorary chairman of the M.I.T. board of the Massachusetts Institute of Technology.

Tenth Anniversary. JESS H. DAVIS, Mem. ASME, has completed his first ten years as president of Stevens Institute of Technology. He was inaugurated as president on Oct. 12, 1951.

Metal-Cutting Research on Display. ORLAN WILLIAM BOSTON, Fellow ASME, and professor emeritus, University of Michigan, has delivered to the Smithsonian Institution some of his pioneering work in metal-cutting studies. Part of his collection of machine tools, instruments, and papers, evidence of his pioneering work on metal cutting done in teh 1920's, will compose an exhibit to be called "What Happens When Metal Is Cut."

The title was first used on a paper Prof. Boston presented before ASME in 1930. The exhibit will go in the Hall of Tools of the Institution's new Museum of History and Technology begun in July.

ASME Publications

THE following publications are available from the ASME Order Department, United Engineering Center, 345 East 47th Street, New York 17, N. Y.

Power Test Codes

● "Temperature Measurement," Part 3 of the series, replaces a segment of the test codes originally published in eight chapters during the period 1931–1945. The 118-page volume includes nine chapters on such topics as calibration of instruments, various kinds of thermometers, and optical pyrometers. The first chapter also includes a summary discussion of temperature measurement as related to power test code work with particular emphasis on basic sources of error and means of coping with them. Copies are available at $5 each, with a 20 per cent discount to ASME members.

● "Measurement of Shaft Horsepower," Part 7, is a new addition to the series. It describes in 29 pages the various types of instruments and methods of measurement likely to be prescribed in any of the ASME Power Test Codes, including limits and sources of error, method of calibration, and precautions. Price: $2.50, with a 20 per cent discount to ASME members.

● "Measurement of Rotary Speed," Part 13, is a revision of an earlier edition last revised in 1939. Much of it is identical with the current "AIEE Guide on Rotary Speed Measurements." Its primary purpose is to describe the instruments and methods commonly used for the measurement of rotary speed or slip and to give information regarding the characteristics and limitations of commercially available instruments used in connection with the testing of any rotating machinery, turbine, blower, or electric motor. The 17-page pamphlet is priced at $2, with a 20 per cent discount to ASME members.

Standards

"Guide for Selecting Greek Letters Used as Letter Symbols for Engineering Mathematics," ASA Y10.17-1961, available for $1.

LITERATURE

ASME Transactions

Transactions of the ASME, 1960, are available in three sections: Power and Industry, Section 1; Heat Transfer and Basic Engineering, Section 2; and Applied Mechanics, Section 3. The three sections contain the 371 papers and discussions published in the five 1960 Transactions Quarterlies. Each section is cloth bound and indexed. All three are available at $38 ($41 outside the U. S. A.), and any one is $16, with a 50 per cent discount to ASME members, engineering universities, and public libraries. The price must include handling charges if remittance does not accompany the order. A list of contents is available free on request.

Heat Transfer

"International Developments in Heat Transfer" includes in five paper-bound books the 124 papers presented at the Boulder, Colo., Conference of Aug. 28–Sept. 1, 1961, which was organized and sponsored by ASME and The Institution of Mechanical Engineers. The volumes represent a review of the decade's development in the field of heat transfer and in the design of heat-transfer equipment.

Part 1 includes the papers on heat conduction and thermoelectric effects and heat transfer in equipment; part 2, boiling and burnout, condensation and two-phase flow, high-speed flows, aspects of external convection and vibrations and pulsating flows; part 3, internal and duct flow papers; part 4, problems associated with mass transfer, packed and fluidized beds, radiation, thermal properties, and instrumentation; and part 5 consists of additional papers on heat transfer in equipment and on free convection.

The five books, totaling 1039 pages, are available only as a set for $22 to ASME members and nonmembers.

Government Publications

NSF Survey. "Reviews of Data on Research and Development, No. 27, Scientists and Engineers Engaged in Research and Development in Colleges and Universities, 1958," announces the findings of a survey on the expenditures and manpower resources in 1958. It was found that almost 70,000 of the scientists and engineers at U. S. colleges and universities—44 per cent of the total—were engaged in research and development.

Copies are available at ten cents apiece from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

NBS. "Thermal Expansion of Technical Solids at Low Temperatures, a Compilation From the Literature," by Robert J. Corruccini and John J. Gniewek, National Bureau of Standards Monograph 29, issued May 19, 1961, 24 pages. Price: 20 cents. Order from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

OTS. The following publications are available from the Office of Technical Services, Business and Defense Services Administration, U. S. Department of Commerce, Washington 25, D. C.

● "Experimental Organic Cooled Reactor Conceptual Design," IDO-16570, by W. E. Nyer and J. H. Rainwater, Phillips Petroleum Company. Price: $2.50.

● "Plutonium Recycle Test Reactor Final Safeguards Analysis—Supplement

2—Consequences of a Primary Coolant Leak," HW-61236 SUP 2, 66 pages, by N. G. Wittenbrock and J. Muraoka, General Electric Company. Price: $1.75.

● "Design Analysis of a Prepackaged Nuclear Power Plant for an Ice Cap Location," APAE-39, by Alco Products, Inc.; 459 pages. Price: $5.50.

● "Preliminary Design of a Basic Radiation Effects Reactor (BRER)," ANL-6332, by D. R. MacFarlane and others, Argonne National Laboratory; 61 pages. Price: $1.50.

● "Argonaut Reactor Databook," ANL-6285, by W. J. Sturm and D. A. Daavetrila, Argonne National Laboratory; 177 pages. Price: $2.75.

● "Symposium on Nondestructive Testing Trends in the AEC Reactor Program," TID-7600, by U. S. Atomic Energy Commission; 86 pages. Progress in nondestructive testing of nuclear reactor components is presented in four papers totaling 86 pages. Report is $2.

● "Proceedings of the Power Reactor In-Core Instrumentation Meeting," TID-7598, from the AEC. This illustrated report describes sessions during the recent two-day, six-session seminar in Washington, D. C. The 117-page report is $2.50.

● "Maritime Reactor Project Annual Progress Report for Period Ending November 30, 1960," ORNL-3046, by H. C. McCurdy, Union Carbide Corporation; 62 pages. Price: $1.50.

● "Maritime Gas-Cooled Reactor Program—Quarterly Progress Report for the Period Ending March 31, 1960," GA-1259, by General Dynamics Corporation. Price: $3.

● "Commercial Standard CS231B-61, Aircraft Hangar Doors of the Individually Power Operated Horizontal Sliding Type (Steel Frame)," is the second in a series of eight standards proposed by the Hangar and Industrial Door Technical Council to establish standard quality criteria for the design and fabrication of large individual leaves. The first standard in the series, Commercial Standard CS 231A-60, covers smaller, manually positioned leaves. Standard CS231B-61 is ten cents.

Russian Literature

● "Foreign Developments in Machine Translation and Information Processing, No. 30," 61-31465, is a 48-page Soviet study on various phases of research in processing scientific information. It is available in English from OTS, U. S. Department of Commerce, Washington 25, D. C. Price: $1.50.

● "Soviet Research on Gravitation: An Analysis of Published Literature," 61-11187, was compiled by the Garbell Research Foundation, San Francisco, Calif., for the Library of Congress. The 389-page study is available from OTS. Price: $5.

● "Manual of Semiconductor Triodes and Diodes," 61-31116, was published in Moscow in 1961. The 450-page manual is available in English from OTS. Price: $6.

AEC

● "IAEA Research Projects," TID-11404, is a summary of research contracts awarded and supported by the International Atomic Energy Agency through Dec. 31, 1960. The contracts cover eight areas of research, including safe disposal of radioactive wastes, health, physics and radiation protection, radiobiology, safeguards, power-reactor studies, and applications of radioisotopes in medicine and agriculture. The 16-page report is available from the U. S. Atomic Energy Commission, Washington 25, D. C.

● The Atomic Energy Commission has released 21 research reports on reactors. These are for sale through the Office of Technical Services, Business and Defense Services Administration, U. S. Department of Commerce, Washington 25, D. C. Further information may be obtained by writing to Publications and Public Information Division, OTS.

● Eighteen research reports on metallurgy, ceramics, and materials also have been released through OTS by the AEC, and further information on these is available from the Publications and Public Information Division, OTS.

Books

● "Current Trends in Scientific Research," is a survey of the principal lines along which research is being undertaken in every field of science. The author, Pierre Auger, a leading French physicist, also makes recommendations for the future dissemination and application of scientific knowledge. The sciences of mathematics, physics, chemistry, biology, earth and space sciences, medical sciences, and food and agricultural sciences are all covered in detail. Published by UNESCO, Paris, the 245-page book is available for $6.75 from the International Documents Service, Columbia University Press, New York 27, N. Y.

● "Patents For Management" points out the profits and pitfalls in the everyday use of patent and anti-trust laws. Worth Wade, the author, also wrote "Patents for Technical Personnel" (2nd edition, 1957), and is a patent attorney. The handbook can be obtained from Advance House, Publishers, P. O. Box 334, Ardmore, Pa. Price: $5.50.

● "Lesson Guide Outline on Material Handling Education" is a 166-page outline enclosed in a loose-leaf binder. It is designed for use by college instructors as well as by industrial firms and trade and professional associations. Composed of 20 separate units or sessions, it covers such topics as warehousing, outdoor handling and storage, maintenance, principles, analysis of handling problems, packaging, selection of equipment, powered industrial trucks, and the effect of handling on facility layout. Author of the outline is James M. Apple, Mem. ASME, vice-president of Clarke Floor Machine Company, Muskegon, Mich. Copies are available to industrial firms and professional organizations at $20 each and may be obtained from the Material Handling Institute, Inc., One Gateway Center, Pittsburgh 22, Pa. Complimentary copies are available to professors who address their requests on college or university letterhead; and additional copies to the same school are $5 each.

News In Pamphlets

● Science Education Experiment. The complete report on the "School-Industry Cooperation Project in New Jersey" describes the pilot experiment in science education launched in 1958 through co-operation of New Jersey industrialists and educators. The program, which was financed by 26 industries, has been incorporated as a permanent part of the State Department of Education program. It provides for interaction between teachers and industrial scientists, for student visits to research laboratories, and for industrially sponsored lectures and demonstrations. The report is available free from the Thomas Alva Edison Foundation, 8 West 40th Street, New York 18, N. Y.

● A new booklet detailing the work of the International Organization for Standardization (ISO) has been announced by the American Standards Association. Published in conjunction with the ISO General Assembly meeting held in Helsinki in June, the first edition of the ISO Memento offers practical information on ISO activities and projects being considered. The preface and technical committees are printed in English, French, and Russian. The balance of the text is French and English in adjoining columns. The 64-page brochure is available at $4.80 from the U. S. member of ISO, American Standards Association, 10 East 40th Street, New York 16, N. Y.

● "Coming! Automatic Control's Greatest Era," by George M. Muschamp, Mem. ASME, is a 15-page booklet on the automatic operation of the plant and the office. His remarks are based on an

(Continued on page 119)

United Engineering Center

ASME Member Gifts Campaign: Dayton Section New Leader

A NEW leader emerged among the Sections. Dayton takes over the top spot and brings added luster to the already brilliant job turned in by Region V. An achievement of 192 per cent of quota is an outstanding performance.

Thirty-seven Sections are now over the top; the newcomers since the September report are Pittsburgh and Mexico. We welcome them both to the honor rolls. There are ten Sections with less than $500 needed to meet their quota. New London is $30 short and Mid-Hudson but $46 short. These sums should be easy to raise between now and the end of the year. Greenville and Piedmont-Carolina have made excellent progress during this past year; it would be fitting to have both achieve their goals. Additions to the ten first below 100 per cent are Central Kansas and N. E. Florida. The latter Section is to be commended for their 1961 drive, they have come from 9.2 per cent to 70.6 per cent of quota; let us hope they join N. W. Florida in the 100 per cent club. The loyalty to ASME is there, if it can be motivated in the right direction.

Kansas City has raised $1500 of the $1700 needed at this time last year. We look for them to join St. Louis, Milwaukee, Cleveland, Columbus, and Pittsburgh as members of the 100 per cent club. $233 should not be too big a hurdle to negotiate before December 31.

Recent returns have come in from Los Angeles, Dallas, San Antonio, and the Florida Section; also North Jersey and Mid-Jersey are working on clean-up campaigns. The same is true of the Toledo and Akron Sections where the ambition to join the honor roll along with eleven other Region V Sections drives them on.

It is a pleasure to report on our successes. Now a word of caution to those Sections currently less than 110 per cent of quota. A spot check of one Section shows that it will slip once again from the honor roll if steps are not taken to promote payment of delinquent pledges. In February an analysis will be made, section by section, of overdue accounts. A report will be sent to each section requesting help in the reduction of delinquent accounts. Everybody will have a chance to help themselves remain on the honor roll. The most recent report from the United Engineering Trustees shows that $100,682 ASME pledges remain unpaid, in 3589 accounts. Approximately $20,000 of this amount is not only overdue but includes pledges over three-years old upon which nothing has ever been paid. We still have a clean-up job to do.

Sections Achieving 100 Per Cent Quota or Better

Section	Per cent
Dayton	192.0
Waterbury	186.7
Cincinnati	169.1
C A M	158.3
Worcester	157.1
Youngstown	155.7
N. W. Florida	146.0
Hudson Mohawk	144.9
West Virginia	136.7
Metropolitan	131.8
Atlanta	130.7
Providence	125.5
Detroit	124.2
Fairfield	123.9
Hawaii	122.7
Southern Tier	120.8
Central Iowa	118.7
Birmingham	118.5
Anthracite Lehigh	117.2
Columbia Basin	116.4
Westmoreland	110.0
Olean	108.8
Central Indiana	108.7
Milwaukee	108.4
St. Louis	108.3
Gulf Coast	107.1
Columbus	106.9
Mexico	106.6
Erie	105.8
San Diego	105.6
Sabine	105.4
N. Ala.-Miss.	105.1
Cleveland	104.4
Inland Empire	104.3
Fort Wayne	103.5
Iowa, Illinois	103.1
Pittsburgh	100.9

Sections Short of Quota

Sections	Dollars
New London	30
Mid-Hudson	46
Greenville	146
Red River Valley	149
Central Kansas	223
Piedmont-Carolina	225
Kansas City	233
Nebraska	411
Susquehanna	446
N. E. Florida	471

MEETINGS OF OTHER SOCIETIES

• IN THE UNITED STATES

January 8–12, 1962

SAE, 1962 Automotive Engineering Congress and Exposition, Cobo Hall, Detroit, Mich.

• IN EUROPE

January 8–12, 1962

International Heat Transfer Conference, sponsored by The Institution of Mechanical Engineers (in co-operation with U. S., including ASME; U. K.; and Canadian societies), London, England.

June 20–26, 1962

The Institution of Chemical Engineers' symposium on "Interaction Between Fluids and Particles," first part of the Third Congress of the European Federation of Chemical Engineering, London, England.

June 20–30, 1962

Second Chemical and Petroleum Engineering Exhibition, sponsored by the British Chemical Plant Manufacturers Association and the Council of British Manufacturers of Petroleum Equipment, Olympia, London.

June 25–28, 1962

Fourth Congress of the Federation of European Petroleum Equipment Manufacturers (Fédération Européenne des Constructeurs d'Equipment Petrolier), Church Hall, Westminster, London.

July 16–20, 1962

International Conference on the Physics of Semiconductors, arranged by The Institute of Physics and The Physical Society on behalf of the International Union of Pure and Applied Physics and the British National Committee for Physics, University of Exeter, London.

October 15–20, 1962

Second International Congress and Exhibition of Laboratory, Measurement, and Automation Techniques in Chemistry (ILMAC), in the Swiss Industries Fair buildings, Basle, Switzerland.

October 18–25, 1962

Third International Plastics Exhibition, "macroPlastic," organized by N. V. 't Raedthuys, at the Croeselaan exhibition site, Utrecht, The Netherlands.

(*For ASME Coming Events, see page 122.*)

Notes on Society Activities and Events

E. S. NEWMAN
News Editor

THE ASME NEWS

FLAG RAISING. Opening ceremony marking Dedication Day of United Engineering Center was raising of the flag to the strains of martial music rendered by 579th Air Force Band, attached to Stewart AFB at Newburgh, N. Y.

UNITED ENGINEERING CENTER

ELDER STATESMAN. Before an audience of his distinguished peers, former President Herbert Hoover, Hon. Mem. ASME and Honorary Chairman of the Dedication Ceremony, presents his address which appears overleaf.

DEDICATED ON NOVEMBER 9

ENGINEERS PLAZA FOR A DAY. By special proclamation of the Mayor of New York City, Robert F. Wagner, 47th Street and First Avenue was named Engineers Plaza in honor of the dedication

DEDICATION CEREMONY. With W. F. Thompson, Fellow ASME, president of United Engineering Trustees, Inc., in role of chairman, the dedication ceremony gets under way as the band plays the National Anthem. Built at a cost of more than $12 million, met in substantial sum by individual contributions, and also in considerable sum by industry, the United Engineering Center is now the headquarters operation for some 300,000 engineers. To bless the Center and those whom it will serve, three eminent religious leaders took part in the dedication: Rabbi Arthur Buch of Astoria Center of Israel gave the Invocation; His Eminence, Francis Cardinal Spellman of the New York Catholic Diocese said the Prayer; and Dr. Dan Potter, executive director, the Protestant Council of the City of New York, the Benediction.

UNITED ENGINEERING CENTER: DEDICATION DAY

HERBERT HOOVER SPEAKS . . .

THIS is a day of rejoicing among the 300,000 engineers in the United States. We have dreamed of this building for many years. We have believed that by housing our 19 different engineering societies and groups under one roof we would have more unity of purpose in our professions. We have believed that we could be of more service to the American people.

We did not deliberately erect this 20-storied structure in order to keep an eye on the United Nations across the street. But we may hope that the fallout of brevity, unity, and constructive action streaming from these rooms might penetrate into their assemblies.

On our side of the street engineers do not need shelter from the radiations of Karl Marx of certain segments of the United Nations.

Our engineering professions have two major responsibilities to the American people.

It is our duty to take the discoveries in science from over all the world and translate them into new inventions, new processes, and new facilities which will keep the American standard of living ahead of all the world. We have long since proved that our nation has the creative genius to do it. The exchange of ideas facilitated by this United Engineering Center will give even more assurance of this service.

We also have a responsibility to see that we maintain the supply of trained engineers needed by our growing economy and our national defense. I regret to say that we have fallen behind the Communists in this field. But with this new united front we can provide the remedy.

It is indeed a great honor which my engineers have bestowed upon me by their request that I should preside at this dedication. Once an engineer you are always an engineer at heart—notwithstanding any temporary departure into other fields of service—for it is the most constructive profession in the world.

It is my great privilege on behalf of the engineers of the United States now to dedicate this building to the service of mankind.

May the blessings of the Almighty rest upon you.

HOOVER MEDAL. Mervin J. Kelly, **left,** former chairman of the board of Bell Telephone Laboratories, Inc., receives 1961 Hoover Medal for "distinguished public service." The Medal was presented by former President Hoover, **center.** Walker L. Cisler, **right,** past-president and Fellow ASME, chairman of the Hoover Medal Board of Award, reads the citation: "Engineer, scientist, distinguished leader in industrial and military research whose dedicated efforts and engineering skill have contributed to greatly improved communications; who has furthered the cause of engineering service to mankind through inspired leadership in the creation of a great United Engineering Center."

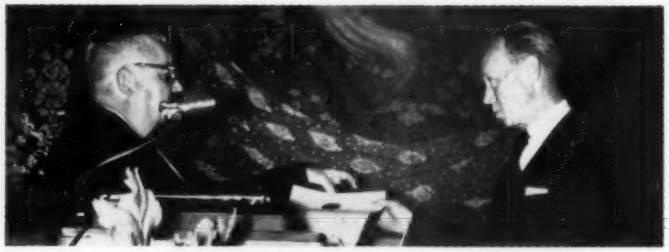
CONGRATULATORY MESSAGE. Said Mayor Wagner: "The City of New York is proud that this neighborhood is becoming more and more the world center for peace and the United Engineering Center adds much luster and strength to an area already dedicated to peace and the welfare of mankind." President Kennedy and Governor Rockefeller also extended congratulations and best wishes.

DEDICATION ADDRESS. Eric A. Walker, president of The Pennsylvania State University, as principal speaker, declared that the rescue of underdeveloped nations from their desperate living conditions will depend, in major degree, on the engineering profession. Engineers and engineering, he said, are largely responsible for the physical conditions under which we live and work. Their work is critical to our national defense and ...to the survival of democracy and to the ideal of the dignity of the individual. If the underdeveloped nations are to be delivered from the crushing poverty and obscene living conditions that blight the lives of their people, it is the engineer who will do most of the delivering.

ENGINEERING STUDENT SPEAKS. William L. Hallerberg, senior, honor student in metallurgy, Missouri School of Mines and Metallurgy, speaking for upcoming generations of engineers, said: "We will be the new tenants, the new landlords, and the new directors. We will use the tools you have forged for us to make strides in engineering unheard of 20 years ago. I am sure that every member of your generation responsible for these accomplishments, especially this building, is proud that he has built for the future. I am equally sure that every member of my generation is grateful for what has been done for us."

ASME MEETINGS ... AT A GLANCE

CODES AND STANDARDS. Members of the Board, its Standing Committees, and Chairmen of Working Subcommittees and ASA Sectional Committees, discuss problems at Arden House, Harriman, N.Y., Oct. 15–17, 1961.



NATIONAL POWER CONFERENCE. **Above,** ASME President W. H. Byrne, **left,** presents George Westinghouse Gold Medal to Gerald B. Williamson, Fellow ASME, of Union Electric Company, during ASME-AIEE Meeting banquet. In **left photo,** President Byrne congratulates Charles Strohmeyer, Jr., Mem. ASME, **center,** recipient of the Prime Movers Committee Award. James M. Landis, a past-president of ASME, looks on approvingly. Mr. Strohmeyer received the award for his 1960 ASME Winter Annual Meeting paper, "Transient Loading Improvements for Large Steam-Electric Generating Units." (See MECHANICAL ENGINEERING, November, 1961, page 124.)

LUBRICATION CONFERENCE. Shown between ASLE-ASME Conference sessions, are M. B. Peterson, **left,** and D. Godfrey. Mr. Peterson is with General Electric and Mr. Godfrey is with California Research Corporation. Featuring numerous theoretical papers in the field of lubrication, the meeting was attended by more than 400 engineers.

SOLID FUELS CONFERENCE. Julian E. Tobey, Fellow ASME, **right,** presents Percy Nichols Award to Otto deLorenzi, Fellow ASME, at the 24th Annual Joint AIME-ASME Meeting. Mr. deLorenzi, a former vice-president of Combustion Engineering, Inc., received the award for meritorious service in the development of color photography techniques used in high-temperature furnace study.

MATERIALS HANDLING. At the Bulk Solids Handling Symposium, Herbert H. Hall, Fellow ASME, **left photo,** discusses standard freight containers for universal carrier interchange. Shown in **right photo** are, **left to right:** Carl J. Schwarzer, a session chairman; David P. Tellett, chairman, General Arrangements Committee; and Harry R. Mack, secretary, Materials Handling Executive Committee. All ASME Members, Mr. Schwarzer is with Westinghouse, Mr. Tellett with Allis-Chalmers, and Mr. Mack is on the staff of Stevenson, Jordan & Harrison, Inc., in N.Y.C.

TECHNICAL PAPERS AVAILABLE

Process Industries Conference

THE papers in this list are available in separate copy form until Aug. 1, 1962. The Process Industries Conference was held in Houston, Texas, October 4–6. Please order only by paper number; otherwise the order will be returned.

61—PID-1 Predicting Process-Gas Performance of Centrifugal Compressors From Air-Test Data, by P. P. O'Neill and H. E. Wickli

61—PID-2 Application of a Centrifugal Compressor to a Complex Gas Mixture, by W. Pechenick

61—PID-3 How Chemical Plant-Community Teamwork Solved a Waste Problem, by G. P. Schrader

61—PID-4 The First Municipal Sea Water Conversion Plant in the U.S., by A. Cywin, R. H Jebens, G. D. Dodd, H. D. Singleton

Lubrication Conference

THE papers in this list are available in separate copy form until Aug. 1, 1962. The ASLE-ASME Lubrication Conference was held in Chicago, Ill., October 17–19. Please order only by paper number; otherwise the order will be returned.

61—Lub-1 Investigation of Whirl in Externally Pressurized Air-Lubricated Journal Bearings, by W. A. Gross

61—Lub-2 A Study of High-Temperature Oscillating Plain Bearings, by W. A. Glaeser

61—Lub 3 On the Optimization of the Stiffness of Externally Pressurized Bearings, by M. T. S. Ling

61—Lub-4 On the Translatory Whirl Motion of a Vertical Rotor in Plain Cylindrical Gas-Dynamic Journal Bearings, by C. H. T. Pan and B. Sternlicht

61—Lub-5 Analysis of Bearings Operating in Turbulent Regime, by V. N. Constantinescu

61—Lub-6 The Toroid Contact Roller Test as Applied to the Study of Bearing Materials, by W. J. Greenert

61—Lub-7 Nonlinear Viscosity Effects in Slider Bearing Lubrication, by C. W. Ng and Edward Saibel

61—Lub-8 Theoretical Contributions to the Study of Gas-Lubricated Journal Bearings, by Y. Katto and S. Soda

61—Lub-9 Counterrotating Journal Bearings, by O. Pinkus

61—Lub-10 The Magnetohydrodynamic Slider Bearing, by W. T. Snyder

61—Lub-11 Experimental Investigation of Oilfilm Behavior in Short Journal Bearings, by Boris Auksmann

61—Lub-12 Development of a Ceramic Rolling Contact Bearing for High-Temperature Use, by K. M. Taylor, L. B. Sibley, and J. C. Lawrence

How to Order

Please order only by paper number; otherwise the order will be returned. You can save the postage and handling charges by including your check or money order made payable to ASME with your order and send both to the ASME Order Department, United Engineering Center, 345 East 47th Street, New York 17, N. Y. Papers are priced at 50 cents each to members; $1 to nonmembers. Payment also may be made by free coupons distributed annually to members, or coupons which may be purchased from the Society. Coupons, in lots of ten, are $4 to members; $8 to nonmembers.

61—Lub-13 Fluid-Lubrication Theory of Roller Bearing (Part 1): Fluid-Lubrication Theory for Two Rotating Cylinders in Contact, by Tokio Sasaki, Haruo Mori, and Norio Okino

61—Lub-14 Fluid-Lubrication Theory of Roller Bearing (Part 2): Fluid-Lubrication Theory Applied to Roller Bearing, by Tokio Sasaki, Haruo Mori, and Norio Okino

61—Lub-15 Analytical and Experimental Study of Externally Pressurized Air-Lubricated Journal Bearings, by J. R. Lemon

61—Lub-16 Solid Lubrication of Metallic Surfaces at Very High Sliding Speeds, by T. D. Witherly

Bulk Solids Handling Symposium

THE papers in this list are available in separate copy form until Aug. 1, 1962. The Bulk Solids Symposium was held in Minneapolis, Minn., October 17–18. Please order only by paper number; otherwise the order will be returned.

61—BSH-1 Dust Explosions, by R. W. Olson

61—BSH-2 Improved Hopper Cars for Bulk Shipment of Materials, by LeRoy Kramer, Jr.

61—BSH-3 Design and Application of Precast Concrete Stave Silos, by H. D. Webb

61—BSH-4 Automation and Control of Proportioning Systems, by I. H. Richardson

61—BSH-5 Selection and Application of Continuous Weigh Feeders, by A. G. van Stolk and D. B. Boeck

61—BSH-6 Design and Application of Closed Loop Pneumatic Conveyer Systems, by H. T. Young

61—BSH-7 Methods of Transporting, Handling, and Storing Coal, by V. A. Frawley and V. H. Wood

61—BSH-8 Getting "Difficult" Materials Out of Bins, by A. D. Sinden

61—BSH-9 Sizes and Types of Standard Freight Containers for Universal Carrier Interchange, by H. H. Hall

61—BSH-10 Dry-Bulk Trailer Equipment, by R. M. Geisenheyner

61—BSH-11 Air-Pollution Consideration in Bulk-Handling Operations, by M. E. McLouth

Fuels Conference

THE papers in this list are available in separate copy form until Aug. 1, 1962. The AIME-ASME Solid Fuels Conference was held in Birmingham, Ala., October 5–7. Please order only by paper number; otherwise the order will be returned.

61—Fu-1 Electrofrac Techniques, by Erich Sarapuu, R. L. Calhoun, and J. W. Clarke

61—Fu-2 An Oscillating Grate Spreader Stoker Installation, by R. P. Perkins

61—Fu-3 Conditions Required to Burn Fuels Safely in Boiler Furnaces, by R. M. Hardgrove

Conducted for the National Junior Committee

STEWART H. ROSS[1]

JUNIOR FORUM

Engineering Management Section

By Albert S. Goldstein[2]

THE ratio of engineers to workers in our country has increased noticeably in the past decade and the trend indicates a further rise. Similarly, the percentage of engineers in managerial positions has also increased—and this also appears to be a trend. In 1956, for example, in the General Electric Company, 80 per cent of all operating department general managers were engineering graduates, as were 74 per cent of division general managers and 60 per cent of the Company's Advisory Council.[3] This increase of engineers in management has caused problems for those who must select and then try to train these men to fulfill the management function.

Attempts have been made to analyze and solve these problems; the literature bulges with proposed solutions of all kinds. However, no specific conclusions have been agreed upon since work situations and requirements vary considerably. What follows is a brief survey of material written on this subject—to determine possible trends and to categorize various philosophies on engineering management selection and training.

The first question to be answered is: Which type is more suitable for engineering management—the engineer performing scientific and technical tasks, or the person trained in skills such as business administration, law, and industrial and labor relations? Obviously, a combination of these factors is desired. However, these combinations are uncommon and there is a tendency for watered-down training when attempts are made to educate so broadly. In addition, engineering management (considered a profession comparable to medicine and law by some) is becoming more scientific and complex and is separated in many respects from other disciplines and, therefore, requires increasingly more specialized training.

Management Prerequisites. From a survey of recent literature on engineering management, it becomes apparent that management prerequisites fall into two basic categories: Personality characteristics, and training and experience. Many authors consider characteristics such as intelligence, leadership skills, knowledge of work, and practicality are essential for good managers. Unfortunately, personality characteristics such as intelligence, honesty, and diligence are easy to list but difficult to define or qualify satisfactorily. Another major problem is that each work situation involves different managerial requirements and characteristics. This is why no common benchmark for management requirements has been evolved.

For lower and even middle-management positions, many authors consider personality characteristics subordinate to technical competence. However, it should be realized that upper management personnel are developed from the lower levels and, therefore, personality characteristics should play a role in selection of all managerial personnel. There seems to be an increased emphasis on considering personality traits with more use and thought given to formal personality tests and interviews. Frequent use is being made of management consultants specializing in the selection and training of engineering administrators.

Surveys. There have been many surveys conducted to determine the personality traits of both engineers and managers. The limited results of these can be summarized in the following statements:

Engineering education is not necessarily an indication of potential managerial talent since good managers have come from all sorts of backgrounds. However, few good engineers come from other than engineering schools, and all training in logical and analytical thinking (parts of an engineering education) are necessary prerequisites for a career in management. Most characteristics considered necessary for a good manager probably apply to good engineers, and good workers as well.

Therefore, a good manager should have some degree of the listed personality traits, but having them does not necessarily mean he will be a good manager. Yet it is usually the best or better technical performers who are selected for supervisory positions in which the technical skills are no longer required or used to any extent. Therefore there is the dilemma of selecting the best technical men to fill positions where technical competence is no longer a prime requirement. A good engineer is lost in the quest for a good (possibly) manager.

One major reason for selecting better technical personnel for supervisory positions is to reward him for his fine performance. The time-honored path of advancement both materially and prestige-wise has been through management. In the current literature and at many technical meetings on the subject of management, there seems to be a trend toward providing parallel paths of advancement through technical lines. This is especially important since the majority of engineers are now below the age of 40. This means that there would have to be a tremendous expansion in engineering organizations to allow a very small percentage of engineers to advance along managerial lines. Advancement opportunities through parallel technical paths is a possible solution.

Technical Competence Is Vital. Before attempts are made to develop an engineer for supervisory functions, his technical competence and performance are considered. Almost all authors agree that an engineering manager should be technically competent in his field. Again, few go beyond this point to define or qualify this technical competence. Do they mean a manager needs more knowledge of his field than those working for him, or ability to contribute technically to a project, or is just a brief working knowledge of the technical field necessary? One frequent answer to this problem suggests dividing engineering management into two functional areas: (1) Direction of technical skills of groups of engineers, and (2) planning, scheduling, and financing of engineering projects. Many authors believe that the chief en-

[1] News Representative, Ordnance Department, General Electric Company, Pittsfield, Mass. Assoc. Mem. ASME.

[2] Engineer, Defense Systems Department, General Electric Company, Syracuse, N. Y. Assoc. Mem. ASME.

[3] W. R. G. Baker, "Personnel Selection and Training for Engineering," *IRE Transactions on Engineering Management*, vol. EM-4, June, 1957, No. 2, pp. 79–81.

gineer should be what the title implies—the top technical mind in the company. To augment the chief engineer, there should be administrative assistants to handle all nontechnical details involved in engineering projects.

This is a dangerous viewpoint because, like the commodity concept of labor, it does not deal with human emotions and traits. To isolate a chief engineer in a technical ivory tower is impractical, and to control engineers with little or no knowledge and understanding of their work is likewise undesirable. It is also unwise to burden engineers with a multiplicity of supervisors which this concept tends to do.

It would appear that a compromise between technical competence and desirable personality characteristics, including training in nonengineering areas, is necessary. This is the prevailing trend in industry.

However, another movement seems to be gaining momentum. This is the area of a formal development and training of a new discipline called "Management." Colleges are developing and offering new specialized courses in management for engineering students. In addition, many companies are setting up formal management and executive training programs for carefully selected engineering personnel.

Although the trend appears to be toward management training programs, there is an inherent weakness here. Engineering personnel are usually first selected and then trained to fill managerial positions. If someone told you he selected engineers by considering personality characteristics and performance in a machine shop and then trained them on the job for engineering functions, you might reasonably doubt his technical competence. This occurs many times in industry as far as selection of managers is concerned. A student is subjected for four or more years to scientific and engineering curricula, trained by industry to perform engineering tasks, and then is promoted to a supervisory position. Managers, on the other hand, receive little or no prior formal training in engineering administration and are trained (if at all) after selection.

Summary. The significant trends and prevailing philosophies of management selection and development can be summarized as follows:

- **Engineers receive the basic analytical and logical disciplines that are prerequisites for management positions. However, other groups also receive this training (i.e., law and finance majors).**
- **Management positions in engineering companies are increasingly being filled by persons with engineering backgrounds. This is true today for lower and middle management and probably means that in the future engineers will fill the highest management positions.**
- **Formal management selection procedures are being developed and used. In addition, formal management courses appear more frequently in both industry and academic institutions.**
- **There is a trend developing toward providing parallel-path advancement for engineers so that engineering talent is not wasted in managerial positions.**
- **There is some talk of recognizing and treating management as a separate discipline replete with its own training and philosophy. The inference here is that management might have its own separate curriculum.**

It can also be concluded that many of the desirable personality traits for good managers are developed from birth and therefore engineers cannot boast of a monopoly in this area. However, engineers as a whole do have adequate training in logic and analytical thinking which is a prime prerequisite for management. Many engineers in the past have regarded their technical training and competence as a stepping-stone to greater rewards through management. Trends indicate that this prevailing attitude may be subsiding due to increased graduate education, greater numbers of engineers, fewer managerial positions available percentagewise, and the prospects of more prestige and material rewards along technical lines.

Literature (*Continued from page 111*)

address prepared for the Fifth Conference of Manufacturing Automation at Purdue University, April 17–19. The booklet is available from Minneapolis-Honeywell Regulator Company, Brown Instruments Division, Wayne and Windrim Avenues, Philadelphia 44, Pa.

Miscellanea

The Sixties. The 1960's promise to be a decade with unprecedented technological development and expansion, and the role of the engineer will at the same time become even more vital, more complex, and more rigorous. With the certainty that "new technology" will mushroom, engineering will be called upon to enter new areas of activity to make human effort more productive, and engineering for the national defense will reach new heights. The path for Engineers Joint Council in this explosive period is already projected. Its role as co-ordinator of vital technical activities of engineers of all specialties has already been underscored. The broadening scope of engineering and the need for integrating the various scientific and engineering disciplines creates a challenging opportunity for EJC to promote greater interdisciplinary and intersociety co-operation and more efficient and effective co-ordination of activity. (See 1960 EJC Annual Report, $1 a copy from EJC, 345 East 47th Street, New York 17, N. Y.)

● A packaged system of code-punched cards to provide industry with current high-temperature strength data of metals and alloys is now available from the American Society for Testing Materials. The high-temperature strength data recorded on the cards are collected and compiled by the ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals. The data include chemical composition, heat treatment, microstructure, hardness, short-time tensile properties, original creep and rupture data, and creep and rupture strength. They are punch-coded for selective sorting by material, form, type of test, alloy, producer of the material, and source of data. For initial distribution the cards are supplied in groups of about 25 each:

Group 1 (not yet available)—Light alloys (aluminum, magnesium, titanium, copper, beryllium, lithium, and zirconium).

Group 2 Iron and steel including the AISI stainless steels. Price: $7.50 for 25 cards.

Group 3 Superalloys, refractory alloys, and miscellaneous alloys. Price: $7.50 for 25 cards.

Miscellaneous Group, which cuts across Groups 1, 2, and 3, includes data collected early in the program. Price: $7.50 for 22 cards. A code book accompanies each set of cards, which may be purchased from the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa.

INDUSTRIAL FILMS

Technical Information

"Technical Information Services of the AEC," 16-mm, nontechnical film, surveys available unclassified atomic energy literature. The 20-min, color motion picture shows how this information may be located, obtained, and used. It tells about the information available at 85 domestic and 85 foreign AEC Depository Libraries located throughout the world, and details the services of the AEC's Office of Technical Information. The film is available from AEC's do-

mestic and overseas film libraries. Prints also may be purchased from the Motion Picture Service, U. S. Department of Agriculture, Washington 25, D. C., at $87.22 per print for one to four prints; $79.33 for five to 49 prints, including the shipping case.

Vacuum Pouring Process

"Vacuum Pouring for Better Forgings," winner in the Industrial and Technical Processes category at the 1961 American Film Festival—held under the auspices of the Educational Film Library Association—is available on free loan. Its sponsor, Bethlehem Steel Company, is offering it to industrial, technical, and college groups. The 13-min sound and color film uses live action and animation to show every step of the vacuum-pouring process. A high-speed sequence, filmed at 1000 frames per sec, shows trapped gases exploding into the vacuum as the metal cascades into the ingot mold. Requests for prints or information may be sent to Modern Talking Picture Service, 3 East 54th Street, New York 22, N. Y.

CERN

"Matter in Question," a 25-min color film, explains the operation and the equipment of the European Organization for Nuclear Research (CERN). This organization employs about 1400 persons from 14 member states to help increase the fundamental knowledge of high-energy physics. The first sequences of the film recall the history of the study of atomic and nuclear structure, showing some of the contemporary personalities in the world of physics. The film was made by the French-Brazilian producer George Pessis. It will be available for noncommercial projection through the main national centers of information in Europe. Also, 16 or 35-mm copies can be obtained from the Public Information Office, CERN 23, Geneva, Switzerland.

Niagara Power

"A Report on the Niagara Power Project" tells the detailed story of one of the world's largest peace-time construction jobs. The 25-min, 16-mm, black and white film shows the $720 million project with emphasis on the giant penstock installation and excavation procedures in the conduit and other areas. It also describes services performed on the project under the B. F. Goodrich Unified Contractor Program. The film is available to construction, contracting, and engineering groups through zone and district offices of The B. F. Goodrich Company, and from the company's headquarters, Akron, Ohio.

Freeman Fellowship for Study or Research in Hydraulics

QUALIFIED members of The American Society of Mechanical Engineers or the American Society of Civil Engineers who have a worthy research program in hydraulics or related fields, may apply to the Freeman Award Committee of ASME for fellowship support. The 1962–1963 award can be as much as $3000, depending on the need claimed in the application.

The ASME and ASCE are joint administrators of the Freeman Funds. The Freeman Award Committees make awards through these Societies in alternate years (through the ASME Committee in 1962). The conditions under which fellowship applications will be studied are as follows:

1 Each applicant must submit a proposed study or research program covering a period of at least nine months starting in 1962. Each shall include a statement of the funds needed from the Fellowship.

2 Each applicant shall furnish evidence of his qualifications to carry out the proposed program.

3 Applicants must be citizens of the U.S.A. or Canada and members of either of the co-operating societies.

4 Applications must be submitted to the Freeman Award Committee, c/o Secretary, The American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York 17, N. Y., by April 15, 1962.

5 Announcement of the award will be made when the recipient has been selected.

6 A report, in English, must be made by the awardee within 60 days' after completion of his project.

7 The income from the Fund is to be used in the aid and encouragement of young engineers, especially in research work for:

(*a*) Grants toward expense for experiments, observations, and compilations to discover new and accurate data that will be useful in engineering.

(*b*) Underwriting fully or in part some of the loss that may be sustained in the publication of meritorious books, papers, or translations pertaining to hydraulic science and art which might, except for some such assistance, remain mostly inaccessible.

(*c*) A prize for the most useful paper relating to the science or art of hydraulic construction.

(*d*) A traveling scholarship, open to members younger than 45 years, in any grade of membership, in recognition of achievement, or promise; and for the purpose of aiding the candidate to visit engineering works in the United States or any other part of the world where there is good prospect of obtaining information useful to engineers.

(*e*) Assisting in the translation, or publication in English of papers or books in foreign languages pertaining to hydraulics.

ASME Elects Ten to Grade of Fellow

ASME has honored ten of its members by electing them to the grade of Fellow.

To qualify a nominee must be an engineer with acknowledged engineering attainment, have 25 years of active practice in the profession of engineering or teaching of engineering in a school of accepted standing, and be a member of the Society for 13 years. Promotion to the grade of Fellow is made only on nomination by five Fellows or Members of the Society to the Council, to be approved by the Council.

These men were so honored for their outstanding contributions to their profession and to the Society:

Harry L. Decker, mechanical engineer, Pennsylvania Railroad, Philadelphia, Pa., assisted in the full-scale dieselization of the Pennsylvania Railroad, beginning in 1945. He is a member of a committee to study extended electrification on various portions of that railroad, a project that involves all types of motive power and rolling stock equipment. Mr. Decker has the responsibility of establishing the mechanical standards and making necessary designs for the construction of the railroad's rolling stock and equipment, including electric and diesel locomotives, passenger cars, freight cars, maintenance apparatus, and material-handling machinery, with regard to operating cost and compatibility with the Interstate Commerce Commission rules and the Association of American Railroads Manual of Standard and Recommended Practice. His projects have included work on 85-ft "piggy-back" flat cars, 70-ton covered gondolas, and diaphragm suspension for passenger cars. He holds several significant patents on railway equipment.

Herbert H. Hall, materials handling engineer, Aluminum Company of America, Pittsburgh, Pa., has developed various plans for using shipping containers in the intra and interplant movement of bulk and unit commodities. In 1943 and 1944, he revamped Alcoa's

Lafayette, Ind., works to meet the war demand, and since then has made a logistic study of the proposed Alcoa plant in Alaska. He also has compiled military aluminum requirements and capacities of Alcoa's manufacturing facilities for Government agencies in Washington, D. C. He has written numerous papers on the standardization of shipping containers, and made many scientific and industrial reports on German light metal industry for the Department of Commerce. Through his paper "Standard Sizes of Shipping Containers for Carrier Interchange," ASME Paper No. 57—SA-82, Mr. Hall contributed to the creation by ASME, ASA, and the American Material Handling Society of the ASA Sectional Committee MHS on Sizes of Shipping Containers, of which he was made general chairman. He was chairman of the Joint AMHS-ASME Material Handling Handbook Committee in 1952–1957, and presently is chairman of the Technical Division AMHS as well as AMHS representative on the American Standards Association Committee.

John F. McLaughlin, vice-president and general manager of operations, Iowa Power and Light Company, Des Moines, Iowa, was elected Fellow ASME for his work in furthering the day-to-day development of procedures and methods in the general operation of power plants. He was directly responsible for his company's decision to install one of the first tangential-fired boilers ever built and for several of the changes made in the development of this type of burner in making it suitable for the use of low-grade Iowa coal. The latter development was a boon to the Iowa coal industry. Mr. McLaughlin also initiated a comprehensive training program for power-plant operators prior to the operation of a new station, a practice now accepted by many Iowa utilities.

William Martin Nichols, chief engineer, Diesel Research and Development, Alco Products, Inc., Schenectady, N. Y., has been active in the diesel-engine field throughout the major part of the period in which this engine has been a significant power source. Formerly with McIntosh and Seymour Engine Corporation, a pioneer company in diesel engine development that was bought by Alco in 1929, he has been involved in the construction, design, development, and research of the engine and holds more than 40 patents on its components. He headed the engine-development program that pioneered direct fuel injection, the use of port-controlled pumps in high-pressure injection, and the first application in the United States of turbosupercharging on diesel engines. He also helped pioneer the trend to high mean effective pressure, so that today Alco is regarded as the leader in the high-output diesel engine field. He did preliminary work on the V-type locomotive engine and headed the development of Alco models 244 and 251 diesel engines, the latter model attaining a world-wide reputation for ruggedness and reliability.

During Mr. Nichols' career, diesel engines have progressed from operation in the early thirties at piston speeds of 700–900 fpm with mean effective pressures of 70 psi to speeds of 2000 fpm with MEP's of over 200 psi; from a weight of 200–400 lb per hp to less than 15; and with a drop in fuel consumption from 0.45 to 0.36 lb per brake hp.

O. B. Schier, II, Secretary, ASME, helped to revise and implement the ASME Student Member Program, which went into effect in 1956, and played an important part in setting up the Society's procedure to make available pamphlet copies of technical papers presented at its meetings. He was appointed Secretary to the ASME Professional Divisions Committee in 1946, and later was Meetings Manager. In 1953 he became Assistant Secretary, advancing to Deputy Secretary in 1956, and Secretary in 1957. During the war, he was an officer in the U. S. Navy working with the War Production Board as liaison between Navy bureaus and manufacturers. He aided in the successful operation of the Naval Industrial Cooperation Plan in New York State, which enabled smaller manufacturers to bid on Navy contracts.

Kenneth A. Browne, director of research, Chesapeake and Ohio Railway Company, Cleveland, Ohio, is a leader in railroad equipment development. He pioneered the application of low-alloy high-tensile steel to freight-car equipment and contributed to the development of low-weight, low-center-of-gravity passenger equipment. His present work on a combined rail-highway vehicle is of great importance to the transportation industry. During his early career with Wright Aeronautical Corporation, Mr. Browne greatly contributed to the development of such components as the turbosupercharger, sleeve valves, fuel injectors, pressure carburators, and automatic power controls, and to the dynamic suspension of aircraft motors. The latter project made possible the development of large multiengine aircraft. He has been a member of the ASME Executive Committee and chairman of the Railroad Division, as well as a member of the executive committee of the Gas Turbine Division. In 1939 he received the Wright Medal of the Society of Automotive Engineers.

Walter J. Kinderman, director of engineering research, Yarnall-Waring Company, Philadelphia, Pa., conceived and developed the Yarnall-Waring liquid level indicator, a major contribution to the successful operation of modern boilers. He also developed the modern design of the GUN-PAKT Expansion Joint, in particular the feature for controlling the flow of plastic materials through check ports that act as non-return valves, and devised the construction of the Yarnall-Waring differential pressure transmitter. He is still contributing to the measurement of fluid flow, and to the development of valves and thermodynamic steam traps.

G. Ross Lord, professor and head of the department of mechanical engineering, University of Toronto, Toronto, Ont., Canada, was elected Fellow ASME for his contributions to research and teaching in hydraulics. He has made studies on earth dams, channel design, and stack design, and in mine ventilation. As a consultant to the Ontario Department of Planning and Development on Flood Control since 1945, he has made studies and recommendations on many Canadian watersheds. He also has done log holding boom research in co-operation with the Pulp and Paper Research Institute, Ontario Paper, and Abitibi Power and Paper. Included in his projects on mine ventilation was work on a microprojector for the counting of dust in the prevention of silicosis. He was chairman of the ASME Ontairo Section in 1956. In 1932–1933, he was the ASME John R. Freeman Fellow, studying hydraulics in Berlin, Munich, and Karlsruhe, Germany.

Cornelius C. Welchel, chief mechanical engineer, Pacific Gas and Electric Company, San Francisco, Calif., is experienced in manufacturing and in electrical-system and power-plant design, construction, and operation with major public utility companies in the United States and Europe. He was influential in selecting and developing the Dunkirk-type, reverse-flow, reheat turbine, which contributed to the adoption by the utility industry of the higher efficiency reheat cycle. At present he is engaged in his company's power building program, which includes the construction of about $3^1/_2$ million kilowatts of new steam capacity, including two atomic plants and since 1951 has

(*Continued on page 123.*)

ASME COMING EVENTS

January 24–26, 1962

ASME Second Symposium on Thermophysical Properties, Princeton University, Princeton, N. J.

March 4–8, 1962

ASME Gas Turbine-Process Industries Conference and Products Show, Shamrock Hilton Hotel, Houston, Texas

March 27–29, 1962

American Power Conference, Sherman Hotel, Chicago, Ill.

April 5–6, 1962

ASME-SAM Management Engineering Conference, Statler Hilton Hotel, New York, N. Y.

April 9–13, 1962

ASME Metals Engineering Division—AWS Conference, Sheraton Cleveland Hotel, Cleveland, Ohio

April 10–11, 1962

ASME-AIEE Railroad Conference, King Edward Hotel, Toronto, Canada

April 11–13, 1962

ASME Spring Textile Engineering Conference, N. C. State College, Raleigh, N. C.

April 15–19, 1962

ASME Oil and Gas Power Conference and Exhibit, Shoreham Hotel, Washington, D. C.

April 24–26, 1962

ASME Production Engineering Conference, the Van Curler Hotel, Schenectady, N. Y.

April 30–May 3, 1962

ASME Design Engineering Conference and concurrent Show, McCormack Place-Lakefront Exposition Center, Chicago, Ill.

May 7–8, 1962

ASME Maintenance and Plant Engineering Conference, Royal Orleans Hotel, New Orleans, La.

May 21–23, 1962

ASME Hydraulic Conference, Bancroft Hotel, Worcester, Mass.

June 4–6, 1962

ASME Lubrication Symposium, Deauville Hotel, Miami Beach, Fla.

June 4–8, 1962

Nuclear Congress (Biennial), New York Coliseum, New York, N. Y.

June 5–7, 1962

ASME Fuels Symposium, Rutgers University, New Brunswick, N. J.

June 10–14, 1962

ASME Summer Annual Meeting, Chateau Frontenac, Quebec, Canada

June 18–21, 1962

Fourth U. S. Congress on Theoretical and Applied Mechanics, University of California, Berkeley, Calif.

June 26–28, 1962

ASME Aviation Conference, University of Maryland, Washington, D. C.

June 27–29, 1962

Joint Automation Control Conference, New York University, New York, N. Y.

August 5–8, 1962

AIChE-ASME Heat Transfer Conference and Exhibit, Shamrock Hilton Hotel, Houston, Texas

September 13–14, 1962

Joint Engineering Management Conference, Roosevelt Hotel, New Orleans, La.

September 23–26, 1962

ASME Petroleum Mechanical Engineering Conference, Sheraton-Dallas Hotel, Dallas, Texas

September 24–26, 1962

AIEE-ASME National Power Conference, Lord Baltimore Hotel, Baltimore, Md.

October 4–5, 1962

ASME-AIME Joint Solid Fuels Conference, Penn-Sheraton Hotel, Pittsburgh, Pa.

October 16–18, 1962

ASME-ASLE Lubrication Conference, Pittsburgh Hilton Hotel, Pittsburgh, Pa.

November 25–30, 1962

ASME Winter Annual Meeting, Statler Hilton Hotel, New York, N. Y.

(*For Meetings of Other Societies, see page 112.*)

Note: Persons wishing to prepare a paper for presentation at ASME National meetings or Division conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, United Engineering Center, 345 East 47th Street, New York 17, N. Y. Price to nonmembers, 50 cents; to ASME members, free. Also available on request is a "Schedule of Program Planning Dates for Meetings and Publication Deadline Dates." Ask for Form M&P 1315.

Fellows (*Continued from page 121*)

directed the company's nuclear power feasibility studies. A member of the Operating Committee of Nuclear Power Group in Chicago, Ill., he participated in the studies and investigations that resulted in the decision to build the 180-megawatt Dresden Nuclear Power Station near Chicago, Ill. He holds patents on heat-transfer equipment and on the application of series capacitors to improve transmission-line stability.

Rosser L. Wilson, vice-president of engineering, Railroad Products Division, American Brake Shoe Company, New York, N. Y., has had long experience with brake systems and engine controls, principally for use on railroads. He developed the carbon insert brake shoe for high-speed railway equipment; a device for preventing wheel sliding on passenger cars during braking; and an acceleration device for controlling train brakes to effect a predetermined retardation rate. He also developed the wheel slip control device for locomotives. Other projects on which he worked were a method for controlling internal hardness of metal castings (brake shoes) during manufacture; equipment for controlling and synchronizing propeller speed on multiengine aircraft; and an automatic switch stand designed to permit trailing movement of railway cars without damage to switch mechanism or track. He participated in the design and development of the brake system and friction elements on the first rocket sled for study by the U. S. Air Force of human reaction to high deceleration rates. The sled was designed to stop in 30 ft from a speed of 200 mph. Mr. Wilson was chairman of the Railroad Division in 1960.

ACTIONS ASME EXECUTIVE COMMITTEE

A MEETING of the Executive Committee of the Council was held in the Council Room of the Society on Friday, Oct. 6, 1961. There were present: W. H. Byrne, President; D. E. Marlowe, H. N. Muller, L. N. Rowley, and R. B. Smith of the Executive Committee; G. B. Thom, Vice-President; E. J. Kates, Treasurer; E. J. Schwanhausser, Finance Committee Chairman; T. Y. Mullan, Professional Practice Committee; O. B. Schier, II, Secretary; W. H. Larkin, S. A. Tucker, and J. D. Wilding, Assistant Secretaries; J. J. Jaklitsch, Jr., Editor; H. I. Nagorsky, Controller; A. B. Conlin, Meetings and Professional Division Manager; D. B. MacDougall, Associate Head, Field Service; and C. R. Tunison, Advertising Manager.

Sections. ***Cape Canaveral Group of the Florida Section.*** The Executive Committee of the Council authorized the formation of the Cape Canaveral Group of the Florida Section with headquarters at Indian River City and the boundary to be the County lines of Brevard County.

Meetings Committee. ***1961 Towne Lecturer.*** An invitation to deliver the 1961 Towne Lecture at the Management Luncheon on Tuesday, Nov. 28, 1961, at the Statler Hilton Hotel, New York, N. Y., has been accepted by Walter Scott of Australia.

Board on Technology. ***Authors of ASME Papers.*** On recommendation of the Board on Technology, the Executive Committee of the Council voted that future preprints and papers presented at ASME meetings and conferences include the Professional Society affiliation as designated on the biographical form by nonmember authors of ASME papers.

Professional Practice Committee. ***New Jersey Assembly Bill No. 546.*** The Executive Committee of the Council endorsed the Resolution of the Professional Practice Committee for transmission to New Jersey Society for Engineers with the request that they present the Resolution protesting the Bill on behalf of all engineers. The Bill would require that anyone engaged in town-planning work would have to be a member of the American Institute of Planners.

Public Relations Committee. ***Proposed Public Relations Program.*** The Executive Committee of the Council authorized the Secretary to implement the Public Relations Program prepared by Raymond C. Mayer & Associates, Inc., to become effective Nov. 1, 1961.

Max Jakob Medal and Award. ***Change of Name.*** The ASME Heat Transfer Division wishes the Max Jakob Medal and Award to be known henceforth as the Max Jakob Memorial Award and that the Citation read: "This award was established in 1961 by the Heat Transfer Division of The American Society of Mechanical Engineers through the generosity of John Wiley & Sons in honor of Max Jakob, pioneer in the science of Heat Transmission, to commemorate his outstanding contributions as a research worker, educator, and author."

1961 Winter Annual Meeting. ***Sunday Evening Conference Topic.*** Two topics for the Joint Conference of Council, Boards, and Committees on Sunday evening, Nov. 26, 1961, were proposed and authorization given to the Executive Committee of the Council to make the final selection after the reports of those assigned to review the Cresap proposals had been heard by the Organization Committee. The Executive Committee of the Council requested the Board on Membership to organize and conduct the program for the Joint Conference of Council, Boards, and Committees on Sunday, Nov. 26, 1961, on the topic "Membership Development and Retention."

Intersociety Relations Committee. ***Report.*** R. B. Smith, Chairman of the ASME Intersociety Relations Committee, presented a report on the conclusions reached by the Intersociety Relations Committees of the AIEE, NSPE, and ASME. The Executive Committee of the Council voted: (*a*) To receive the Report of the Intersociety Relations Committee; (*b*) to endorse and recommend approval of the Report and its attachments by the Council at its meeting on Nov. 26–27, 1961.

Group Disability Insurance Program. ***Report.*** The Report providing cumulative data for the period covering June 1, 1958, to Sept. 1, 1961.

1961 Regional Delegates Conference. ***Summary of Actions.*** The summary of actions taken by the Council on the recommendations presented to the Council on June 11, 1961, is given on pp. 125-126 of this magazine.

International Conferences on Properties of Steam. ***Funds for Secretariat.*** The Executive Committee of the Council authorized a loan from G-53, Research Operating Reserve, for payment of expenses not to exceed $5000 incurred by Prof. Joseph H. Keenan in preparing for the 1962 International Conference on Properties of Steam to be held in Munich, Germany. These funds to be repaid to G-53 after the fund raising has been completed and when funds are available in G-84, Properties of Steam Research.

Chinese Institute of Engineers. ***Golden Jubilee.*** The Executive Committee of the Council appointed G. R. Hahn and A. C. Pasini as Honorary Vice-Presidents

(*Continued on page 125.*)

INSIDE ASME

Nudge From North Jersey

Once upon a time, professional men thought they were entitled—even obligated—to stand delicately aside where politics was concerned. They tiptoed around it. In 1931, ASME had a President—Roy V. Wright—who believed it our duty to get in there and act. Our pride in President Wright's leadership is expressed in the series of lectures in his honor—the Wright Lectures. Most recent Wright Lecture was that given by Walker L. Cisler, president of Detroit Edison, in 1959 (MECHANICAL ENGINEERING, February, 1960, pp. 54–56).

But it seems the idea wasn't entirely original with President Wright. A newsletter from our North Jersey Section shows that other notable men had conceived the same idea. (Incidentally, President Wright was from North Jersey.) We quote:

"A heavy moral obligation rests upon the man of means and the man of education to do their full duty by their country. On no class does this obligation rest more heavily than upon the men . . . of business, of science; the engineer, the architect, the writer . . . all alike owe a positive duty to the community, the neglect of which they cannot excuse on any plea of their private affairs . . ."

The author of this statement: Theodore Roosevelt, in 1890.

What's Your Region?

You might be a little confused about which ASME Region you're in: The Regions are being shuffled around as more are created. In 1959, ASME was divided into eight Regions: It will soon be 11. Smaller areas: Better service. The Regions have Sections, the Sections have Groups—and that's where you meet your fellow Members, and get to know what's going on inside your profession.

What actually happens in these local Sections and Groups? This excerpt from a letter from Region IV (Southeastern States) will give you an idea:

"A total of 53 Members attended the Interim RAC (Regional Administrative Conference) Meetings in Region IV on Sept. 9 and 16 in Atlanta, Ga., and Winston Salem, N. C. Most of the 29 Sections, Subsections, and Groups in the Region were represented . . .

"Two Meetings were held to cut down on the travel distances, since Region IV, as it now stands, can be roughly approximated by a square 800 miles on a side. Attendance was divided according to the division of Region IV which will take place in June, 1962, creating a new Region XI. Luncheons were arranged at both of the all-day Meetings . . .

"There were brisk exchanges of ideas on management of the Sections, program material, and stimulation of growth of membership. Much of the discussion centered on how the local ASME organizations can better serve the young Associate Members. There was also lively comment on how to promote more active participation of engineers in civic and community affairs."

That's your Society.

Cape Canaveral

New Regions? New Sections, too, and new Groups. The Group is the smallest unit, the real "grass roots" of ASME. It can be as small as 25 Members.

We quote from the October Council Meeting:

"A petition . . . for the formation of the Cape Canaveral Group of the Florida Section has been received. On recommendation of Vice-President Robertson, the Executive Committee of the Council voted to authorize the formation of the Cape Canaveral Group with headquarters at Indian River City, and the boundary to be the County lines of Brevard County."

It takes a lot of mechanical engineers to get those birds off the pads.

So Big

Ever wonder just how big your Society really is? A report submitted by the Board on Membership to the Executive Committee of the Council contained this listing of the Membership as of mid-1961:

Student Members	9,713
Assoc. Members ($10)	16,256
Assoc. Members ($20)	4,211
Assoc. Members ($25)	11,090
Members	16,981
Hon. Members, Affiliates, and Fellows	817
Total	59,068

A significant fraction of the approximately 15,000 Associate Members paying dues of $20 or $25 are probably eligible for Member Grade, and could be promoted to that Grade without paying a transfer fee. Merely a matter of filling out a form. How about moving up, and playing your full role in the profession?

It might pay to do it soon—see the article on pages 44-45 of this issue of MECHANICAL ENGINEERING. In a couple of years, Professional Registration in one of the States may be a prerequisite of full membership in ASME. Engineers who are already full Members will, of course, not be affected. Times are changing fast: You grew up under different conditions. Make your position secure, today.

The Well-Informed Engineer

We have a letter from a Student Member who says he doesn't read the feature articles in MECHANICAL ENGINEERING because they are too technical: "Too deep for me."

We wonder how recently he has looked at this magazine.

If he said he couldn't follow articles in one of the *Transactions* publications, we'd agree. In the *Transactions* Quarterlies (*Journal of Heat Transfer*, etc.) we publish the latest technical papers by men who are spearheading the advance in technical investigation. To follow these men, you have to be a full-fledged engineer, and a specialist in their line. That last explains why we have broken *Transactions* into five quarterlies, so that the specialist in materials handling won't be forced to buy heat-transfer literature he may not want (and possibly couldn't follow).

But here at MECHANICAL ENGINEERING, we publish feature articles of "general" and "immediate" interest. Our philosophy: To publish articles that will keep our readers up on the developments in the profession outside their specialties. When one of our regular readers sits down at the luncheon table with an assortment of engineers from various specialties, he should be that outstanding individual, the well-informed man.

—*Maurice Barrangón.*

Council (*Continued from page 123*)
to represent the Society and present greetings to the members of the Chinese Institute of Engineers who will observe the Institute's 50th Anniversary on Nov. 13–16, 1961, in Taiwan, China.

Certificates of Award. ***Section Award.*** The Cincinnati Section has requested a certificate of award for Alvia A. Hafer, who organized and conducted a successful lecture series on High-Temperature Materials during 1959–1960. The Executive Committee of the Council authorized the preparation of a certificate of award for Alvia A. Hafer for conducting a successful lecture series on High-Temperature Materials for the Cincinnati Section during 1959–1960.

Board on Codes and Standards. On recommendation of the Board on Codes and Standards a certificate of award has been prepared for Frank P. Tisch for his 15 years of service on ASA Sectional Committee B27.

Retiring Regional Chairmen. On recommendation of Vice-President Robertson (Region IV) certificates of award have been prepared for the following Regional Committee Chairmen: Joel F. Bailey, Sections, 1958–1961; William A. Snellgrove, Jr., Student Sections, 1958–1961; Arthur Croll, Civic Affairs, 1960–1961; Marcus B. Crotts, Honors, 1960–1961; Harold K. Couch, Membership Development, 1958–1961; John C. Reed, Regional Nominating Advisory, 1960–1961; and J. B. Jones, ME Department Heads, 1958–1961.

Retiring Faculty Advisers. On recommendation of Vice-President Heath, (Region IX) certificates of award have been prepared for the following retired Faculty Advisers: G. V. Parkinson, University of British Columbia, 1957–1961; and Paul J. Waibler, University of Washington, 1958–1961.

Retiring Section Chairmen. On recommendation of their respective Vice-Presidents certificates of award have been prepared for the following retiring Section chairmen: J. H. Hollyday, Susquehanna; Roscoe Meadows, Jr., Eastern Virginia; and H. H. Hauth, Pittsburgh.

ASME Council Actions on 1961 National Agenda Reported

How the National Agenda is compiled for Regional Administrative Committees and Items which ultimately are acted upon by Regional Delegates Conference

AT A MEETING of the Executive Committee of the Council of The American Society of Mechanical Engineers, held at Society Headquarters, New York City, on Oct. 6, 1961, approval was voted of statements and actions on the recommendations of the 1961 Regional Delegates Conference submitted to the Council at the 1961 Summer Annual Meeting, Los Angeles, Calif., June 11, 1961.

These recommendations, the actions of the Regional Delegates Conference on them, and the actions or statements of the Council are reported in what follows. A detailed description of the procedure by which agenda items are prepared and acted upon by the Sections, the Regional Administrative Committees, the Regional Delegates Conference, and, finally, the Council follows the report on the 1961 recommendations.

Final Report on 1961 RDC Recommendations

Agenda Item No. 1A: Registration Fees for General Society Meetings. It is proposed that members attending General Society Meetings be charged a nominal registration fee not to exceed five dollars ($5). Nonmembers are to be charged twice the member fee.

Delegates Action: Approved 19 to 0

Council Action: As ASME is the only Founder Society that does not charge members a registration fee for attendance at national meetings and because of continued rising costs, the Executive Committee of the Council on Sept. 8, 1961, authorized the charging of registration fees for the 1961 Winter Annual Meeting as follows:

Member	$ 5
Nonmember	15
Nonmember Student	1

With the following exceptions: Authors, ladies, student members, immediate family of a member, and guests invited by the President or Secretary.

Members of ARS, EIC, I. Mech. E., societies with membership in EJC or ECPD, and any other societies listed as cosponsors in the program are admitted at the member rate. The following nonmembers will be admitted at the member rate: Session chairmen and vice-chairmen and invited discussers. (No fee to attend social events.)

Agenda Item No. 11A: Authors of ASME Papers. It is proposed that acknowledgment of membership in another professional society be given authors of ASME papers rather than the statement, "Nonmember, ASME."

Delegates Action: Approved 20 to 0

Council Action: On recommendation of the Board on Technology, the Executive Committee of the Council, at its meeting on Oct. 6, 1961, proposed that future preprints and papers presented at ASME meetings and conferences include the Professional Society affiliation of nonmember authors of ASME papers as specified on biographical forms.

Agenda Item No. 13: Form Sheet for Collecting Facts from Sections. It is proposed that a standard form sheet be established by the Society for collecting statistics and pertinent facts from the Sections.

Delegates Action: Approved 18 to 1.

Council Action: This item has been referred to the Committee on Regional Affairs for consideration at its meeting on Nov. 25, 1961, and for report to the Council on Nov. 26, 1961.

Agenda Item No. 23: Annual Dues Statement Include Reminder that Sections Receive Allotments on Paid-up Members Only. It is proposed that the annual dues statement to members include a reminder that their Section will not receive full financial support from National Headquarters for any member whose dues are paid after September 30.

Delegates Action: Unanimous

Council Action: Since the allotment is based on the number of paid-up members at the close of business on September 30 of the previous year, the Executive Committee of the Council on Sept. 8, 1961, recommended that the National MDC and the Local Section Membership Committees urge members in the individual Sections to pay their Society dues by September 30 so that their Section will receive full financial support from Headquarters.

Agenda Item No. 28A: Registration as a Professional Engineer be a Requirement for Member Grade in ASME. It is proposed that at some future date, e.g., 1966, registration as a professional engineer by one or more recognized bodies be one of the requirements for the attainment of Member grade in ASME. It is further proposed that all members (full Member grade) in good standing at the time such a policy is implemented shall continue their membership in that status, even though they may not be registered.

Delegates Action: Approved 15 to 1 (3 abstentions)

Council Action: The Executive Committee of the Council on Sept. 8, 1961, requested the Constitution and By-Laws

Committee to prepare appropriate wording of an amendment to Article C4, Sec. 4 (new C3, Sec. 5) to provide that registration as a Professional Engineer in one or more of the States or territories of the United States or equivalent status in foreign countries be an addition to present requirements for admission to the full Member grade; to provide that after the enactment of said By-Law amendment, all Members in good standing at that time shall continue their membership in that status, even though they may not be registered, and requested the Constitution and By-Laws Committee to submit the proposed wording of the amendment to the Board on Membership for its consideration and report to the Executive Committee of the Council at its Nov. 3, 1961, meeting.

Agenda Item No. 35A: Merit Badge Pamphlet on Mechanical Engineering. It is proposed that the ASME and other Founder Societies undertake to prepare, in consultation with the Boy Scouts of America, a merit badge pamphlet on engineering. The information is to be gaged for comprehension by boys 11–14 years of age. History, scope, education, and work of the engineer are areas to be covered. This would enable a boy to earn an engineering merit badge.

Delegates Action: Approved 17 (2 abstentions)

Council Action: On Sept. 8, 1961, the Executive Committee of the Council voted to refer the matter of a merit badge for engineering to the ECPD Committees on Guidance and Information and to Junior Engineering Technical Society.

Items Rejected

To complete the record, the following items that appeared on the agenda were rejected: No. 1, Registration Fees for General Society Meetings, 17-2; No. 5, The Wording of Requirements for Member Grade Be Modified, 15-4; No. 9, Order Department to Make Shipments More Promptly, 12-6; No. 11, Authors of ASME Papers, 19-0; No. 16, Revise Requirement for Payment of Second Appropriation to Sections, 15-3; No. 18, Interim RAC Meeting for all Regions, 16-1; No. 18A, Interim RAC Meeting for all Regions, 7; No. 18B, Interim RAC Meeting for all Regions, 15-3; No. 22, Members Dues Reduced Upon Retirement, 18-1; No. 25, Headquarters Liaison Committee Be Formed for Co-Sponsored Divisional Conferences, 18-1; No. 27, Registration Fees for Division Conferences, 12-6; No. 28, ASME Membership List use "PE" Designation, 11-8; No. 32, ASME Approach Public Relations More Aggressively, 15-4; No. 35, Merit Badge Pamphlet on Mechanical Engineering, 17-1; and No. 5A, The Wording of Requirements for Member Grade Be Modified, 13-5.

Nominations for ASME Honors

Members and agencies of The American Society of Mechanical Engineers, including Boards, Committees, Sections, and Professional Divisions—except members of the Council and the Board on Honors—are invited to submit nominations for Society honors and awards for the year 1962. These honors and awards, described in the Honors Manual, MS-71, must be in the hands of the Board on Honors prior to March 1, 1962.

It is essential that those wishing to make nominations secure a copy of the Honors Manual in order to fulfill the necessary requirements in submitting such nominations. The Honors Manual may be had by writing to the Board on Honors, ASME, United Engineering Center, 345 East 47th Street, New York 17, N. Y.

ASME Procedure in Preparing and Discussing Agenda Items

The American Society of Mechanical Engineers has developed a procedure whereby action is taken by all Sections on suggestions made by any Section to improve policies, procedures, and operations of the Society. This procedure starts with the compilation by the National Agenda Committee of preliminary statements of the items suggested. If one third of the Sections approve any one item, it is included in a National Agenda for discussion at Regional Administrative Committee meetings held in the spring.

Further discussion at a national level takes place at the Regional Delegates Conference held during the Summer Annual Meeting. The results of this Conference are then submitted to the Council.

The principal business of the Regional Delegates Conference held during the Summer Annual Meeting is to consolidate the actions of the ten RAC meetings on the National Agenda and to report the consolidated view to the Council. Related matters frequently arise on which a consolidated view is developed, or on occasion the Council may request the opinion of the RDC on a Society policy or procedure. The Council is usually in session at the same time as the RDC and provision is made for the Delegates to attend the Council Meeting.

A report of the actions of the Conference is made to Council during the Summer Annual Meeting. The Council after studying the recommendations of the RDC refers to the various administrative agencies of the Society the different items with which those agencies are concerned.

After considering comments received from the administrative agencies, the Council acts on the recommendations of the RDC. These actions were reported to the Delegates and Section Executive Committees on Oct. 6, 1961. They also are reported in Mechanical Engineering as soon thereafter as possible. Thus the cycle from origination of items by the Sections to a reporting of actions by Council is completed within one year.

Compilation of the National Agenda

About September 1 of each year, the chairman of the Agenda Committee sends forms to the Sections and requests the submission of items by the end of October.

Upon receipt of the items, the Agenda Committee reviews them, corresponds with the suggesting Section, and refers the items that can be dealt with promptly as administrative matters to the proper administrative agency.

On December 19, a compilation of all items accepted by the Agenda Committee will be sent to the Sections for an expression of opinion as to inclusion in the final agenda. By Feb. 1, 1962, the Agenda chairman must have all the opinions. One third of the Sections must approve an item before it can become a part of the National Agenda, which is sent out to all the Sections at least four weeks in advance of the first RAC meeting.

Actions in the Sections

The National Agenda requires action in the Section Executive Committee on at least three points:

A In the original suggestion of items. In this process it is desirable to canvass member opinion by some method, by mail, or at a Section meeting.

B The expression of opinion about including an item in the National Agenda.

C A determination of the position the Section is to take on the items in the National Agenda.

It is generally desirable for the Section to select its representatives to the RAC meeting at an early date so that they may be in touch with the entire process of developing the National Agenda.

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC
(Agency)

These items are listings of the Engineering Societies Personnel Service, Inc. This Service, which co-operates with the national societies of Civil, Electrical, Mechanical, and Mining, Metallurgical and Petroleum Engineers, is available to all engineers, members or non-members, and is run on a nonprofit basis.

If you are interested in any of these listings, and are not registered, you may apply by letter or résumé and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee. Upon receipt of your application a copy of our placement-fee agreement, which you agree to sign and return immediately, will be mailed to you by our office. In sending applications be sure to list the key and job number.

When making application for a position include eight cents in stamps for forwarding application.

NEW YORK
8 West 40 St.

CHICAGO
29 East Madison St.

SAN FRANCISCO
57 Post St.

Men Available[1]

Chicago Office

Development Engineer, BSME; 34; three years' product-design and development experience in power-tools field and four years machine design on automatic process equipment in textile fibers and explosives fields. Salary open. Will relocate. Me-2300.

Supervising Test Engineer, Mechanical, BSME; 35; three years' experience developing, testing liquid-rocket components, hardware, now in charge of lab; six years applied research, machines, and devices; 12 years' total experience. Desires stable company and community. $12,230. Prefers Midwest-West. Me-2302.

Plant Manager, BS, MS Production Management; 40; 14 years' experience in industrial engineering, production, metals research, and manufacturing engineering, multiplant consulting service. $15,000 plus. Prefers Midwest. Me-2303.

Project Engineer, BSME; 27; six years' experience in machine design, including mechanical, hydraulic, pneumatic, and electrical circuits. $10,500. Prefers Chicago, Ill. Me-2304.

Engineer, Research or Development, BSME; 38; ten years experience in diesel engine design and development; six years' experience in gas-turbine design and development. Supervisory experience over six technicians and engineers. Experience in making theoretical studies, planning and supervising test programs, and analyzing and reporting test results. $13,000. Prefers Midwest. Me-2306.

Chief Engineer, or equivalent, BSME, Licensed; 38; 17 years' varied experience in design and development; nine years in responsible charge of all engineering on extensive product line major manufacturer of light to heavy material-handling equipment. $13,500. Will relocate. Me-2322.

Project Engineer or Assistant, BSME, PE; 33; total of four years' experience as assistant to chief engineer and research co-ordinator; four years project engineer for power-transmission machinery and bulk materials-handling equipment manufacturer. Considerable customer contact. Capable of co-ordinating project activities and personnel. Will consider employment in new field. $8700. Prefers Southwest or West. Me-2323.

Engineering Manager, BSM3; 41; extremely broad and successful experience in design and manufacture of mining, material-handling, and construction equipment as development, project, and chief engineer. PE, Iowa and Ohio. $15,000–$20,000. Prefers Midwest. Me-2324.

Management Engineer, Sales and/or Production, BSME; 26; experience in production management, industrial engineering, sales. For past 2½ years sales engineer with company engaged in manufacture of process equipment for chemical industry. Seeks and will accept challenge. $8400. Prefers Midwest or West. Me-2325.

[1] All men listed hold some form of ASME membership.

New York Office

Mechanical Engineer, BME, MS; 14 years' experience in petroleum, petrochemical, power, and machinery industries; systems engineering; thermodynamics, hydraulics, heat transfer, appurtenances, piping, instrumentation, etc. $11,000–$12,000. Prefers Metropolitan N. Y., N. J. area. Me-5.

R&D Engineer, Fluid Mechanics, Heat Transfer, Nuclear, MSME; five years' experience in hydraulic, nuclear equipment industry. Design centrifugal pumps, turbines, test evaluation. Design studies: Hydraulic, heat transfer. Computer programming and analysis. $10,000. Prefers West Coast. Me-6.

Teaching, Mechanical and Industrial Engineering, MS; nine years full-time teaching in major engineering school; seven years active duty in USAF (now retired); 3 years' varied industrial experience. $9000 for nine months. New England. Me-7.

Chief Industrial Engineer, BS (Ind. Admin.); 23 years' of industrial-engineering experience; covering incentives, plant layout, methods, manufacturing engineering, tool design, and standard cost. Operations involved machine shop, fabrication, weld, assembly, iron and steel foundries. Minimum $12,000. East. Me-8.

Administrative Engineer, BME, 1956; diversified mechanical-industrial background. Works well with people at all levels to co-ordinate and get job done. Construction, facilities, plant maintenance, flight test, design experience. $9000 plus. Prefers Long Island, N. Y. Me-9.

Mechanical Engineer, BSME (1960); performance studies for experimental gas turbines. Passive analog problems in heat-transfer field for experimental nuclear reactors. Open. Prefers N. Y. C. or Long Island, N. Y., area. Me-10.

Production Supervisor, BSME; 39; seven years progressively increasing responsibilities in supervision of erection and test of steam turbines, marine gears, centrifugal pumps, and compressors; two years' supervision of heavy machining operations; three years test engineer. $12,500. Immaterial. Me-11.

Mechanical Engineer, mechanical and electrical, boilers, steam, diesel, machinery, electrical piping, BS; 28 years' experience in operating, trouble shooting, designing, supervising, maintenance, writing specification, surveying damages, agreeing cost; supervising repairs, installation, and cost; of all types of electrical, steam, and diesel marine-power plants aboard ocean and inland waterways. About $12,000. Immaterial. Me-12.

Manufacturing Executive, ME; extensive, successful experience in engineering and industrial management; determine objectives and programs to meet them; manage facilities planning, manufacturing, engineering, cost-reduction activities, and controls; integrate manufacturing and engineering with sales planning and finance. $18,000. Immaterial. Me-13.

Manufacturing or Maintenance Manager, graduate mechanical; two years supervisor of automotive-maintenance shop; two years service engineer; three years regional inspector; four years specification engineer in manufacturing of heavy machinery. Desires supervisory position with manufacturing or maintenance organization. $9500. Prefers Central N. Y. State. Me-14.

Field Engineer, MSME; six years' experience; seeking position, preferably overseas, where strong R&D background will be of value. $8000. Foreign. Me-15.

Technical Sales Manager, BSME, PE; Pa.; 20 years' experience conducting and directing light and heavy equipment sales and applications. Has capably trained and directed sales staff. Has keen interest to seek and introduce profitable new products. $15,000. Prefers New England or eastern seaboard. Me-16.

Sales Manager or Executive Assistant. Textile engineer, registered PE. Successful background in sales, new product development, and business management. $12,500–$14,500. Prefers New England. Me-17.

San Francisco Office

Management Engineer, Construction, ME, CE; 47; 22 years' experience as construction engineer, project manager, superintendent, estimator in all phases of construction and engineering projects—to top management position on $40-million project for large U. S. company abroad. $18,000–$20,000. Prefers West Coast. Se-1837.

Plant Manager, Plastics, Chemical, ME; 35; nine years' supervision in production and plant engineering. Familiar with budget preparation and control, cost control and reduction, material handling, process and maintenance, industrial relations with professional employees and union personnel. $15,000–$16,000. Prefers San Francisco; located in Mass. Se-1615.

R&D Engineer, Manufacturing, ME (Canada); 38; 12 years management, product, and process development; equipment development, production, and retailing. $15,000. Prefers San Francisco area. Se-1785.

Chief Designer, Steel Fabrication, MSME; 38; ten years design, supervision of weldments, castings, forgings, stampings, estimating, vendor and customer relations, production processes, and equipment. $1300. Prefers Los Angeles. Se-1832.

Sales Engineer, Bearings, Petroleum, ME; 48; 21 years sales, pricing, budgeting, market surveys, supervision, promotion on sleeve bearings, castings, petroleum. $12,000. Prefers U.S.; presently in Pa. Se-100.

Research Engineer, Mechanical, ME; 40; 12 years research and development of mechanical products. Supervisory and engineering material. Five years familiar with chemical, rubber, and plastics producing equipment. $11,300. Prefers San Jose and Peninsula. Se-1761.

Development, Design Engineer, Electromechanical, mechanical background; 40; 15 years design and supervision of machine components utilizing all methods of fabrication, castings machine, weldments, stampings. Plus introduction of finished article into production. $10,000. Prefers San Francisco area; home, N. Y. Se-1522.

Industrial Engineer, Consulting, ME; 33; 11 years diversified manufacturing and management, electric equipment, atomic power, paperboard, and building material industries. Facilities planning and installation first-line supervision, corporate staff control, and trouble shooting. Proved capability in organization planning, manufacturing-feasibility studies, manufacturing-process development, factory layout, methods planning, standards and incentives, cost control, systems and procedures, quality control, production and inventory control, and manufacturing budgets. $800. San Francisco Bay area. Se-1764.

Transport, Sales Engineer, Transport, Material-Handling Equipment, ME; 33; five years material handling, fleet operation, and maintenance in oil industry abroad; five years with auto manufacturer on engine and commercial vehicle defect investigation and sales liaison, $700. West Coast; home, Venezuela. Se-1784.

Design Engineer, Power Application, ME; 46; air-flow analysis, heat transfer, thermodynamics; background of design for aircraft mechanical equipment (pressurization, controls, hydraulics), ship-machinery test and design (pumps, hoists, power equipment), and power distribution. Prefers Calif. Se-1593.

Production Engineer, Electronic, ME; 29; 2½ years' program amplifiers, oscillators; development on electromechanical equipment;

plan test, report on aircraft components; design test jigs, research aircraft. $500. Prefers Calif. Se-1874.

Production Engineer, Industry, ME; 23; maintenance, operational, and supervisory experience in running power plants. Language facilities. Travel experience in many countries; most western states. $6700. Prefers West Coast or Foreign. Se-1638.

Trainee, Design, Heavy Machinery, ME; 23; desires trainee position in mechanical engineering. $400. San Francisco. Se-1818.

Positions Available

Chicago Office

Product Engineer, graduate mechanical, 28–40, at least two years' experience in creative design, research, and development of new products. Knowledge of high production for metal-fastening devices or small mechanical components. Capable of design, development, evaluation, engineering, and programming of ideas or new products to completion stage. Newly organized department manufacturing metal-fastening devices in an established company. Good potential. $8000–$10,000. Employer pays fee. Northern Ind. C-8931.

Industrial Engineer, BSIE-ME, (Bus. Admin.). Some experience in heavy welding and process-plant fabricating. Manufacturing-feasibility studies on new products, economic studies for comparing alternate manufacturing processes. Some budgetary experience; heavier on process and manufacturing end than standards. $10,000–$12,000. Employer will negotiate fee. Chicago area. C-8925.

Product Manager, Conveyer Idlers, mechanical engineer preferred, to 50, to organize and supervise product department, maintain liaison between sales, engineering, and manufacturing. Sales, pricing, and marketing experience essential. Travel. $12,000–$15,000. Employer will pay fee. Ohio. C-8904.

Engineers. (*a*) Systems-sales representatives, commercial and industrial, and government and military; graduate mechanical or industrial, mature, alert, creative, business-oriented individual, experienced in sale of R&D. Must be capable of understanding and selling sophisticated systems studies and complex electromechanical systems which are often electronically or computer controlled to mid-level industrial and commercial executives. Will seek, develop, and conclude sales to industrial and commercial organizations or government and military of systems capabilities in operations research, operations analysis, equipment design development and implementation generally, but not limited to, the field of automatic handling of items or materials. About $15,000 depending on experience. Calif. (*b*) Senior design and development engineer, mechanical graduate, minimum of eight years' experience in development and design of automatic shoe-manufacturing equipment, high-speed textile manufacturing and weaving equipment, can manufacturing and filling equipment, high-speed paper-handling equipment, automatic printing equipment, or automatic packing and packaging equipment, to lead small team effort in design and development of automatic electromechanical equipment involving interaction of fast-moving mechanical elements. Position will include responsibility for creative supervision of concept, design, development, jury-rig construction testing and modification as well as prototype finalization. Responsibility also will include time and cost schedules and budgets. About $12,000. Calif. C-8879.

Plant Engineers, graduate mechanical, civil, electrical, or chemical, to 45, minimum of five years' experience preferably in food or process industry. Duties will include plant layout, installations, and maintenance of equipment. Will be responsible for setting up preventive maintenance program. Man in Peoria, Ill., will supervise staff of about 40. $9000–$10,000. Engineer in Kansas City will be responsible for staff of about 175. $10,000–$13,000. Employer will negotiate fees. C-8872.

Manufacturing Engineer, under direction of president; graduate mechanical or industrial, responsible for directing and co-ordinating manufacturing operations. Will develop manufacturing and production objectives, policies, plans and programs. Determine manpower needs, select qualified supervisors, delegate responsibility, direct and co-ordinate and control subordinate manufacturing departments, co-ordinate activities of other departments, develop budgets of manufacturing expense, plan and supervise flow of materials, planning of production to meet sales-shipping schedules, supervise improvement of manufacturing methods, direct maintenance of quality of production and raw materials, direct procurement of materials, review and analyses of costs, co-operate with accounting department for financial control of manufacturing and production for a manufacturer of precision machinery. $10,000–$12,000. Employer will pay fee. Southern Wis. C-8864.

New York Office

Sales Manager, to head up sales department of 20 to 30 men in the sale of industrial diesel engines to OEM and distributors. Must have experience in a company in this field. $20,000–$25,000. East. W-1009.

Chief Design Engineer, mechanical graduate, preferably with N. Y. State PE license, to take charge of heating, plumbing, air-conditioning design, specifications, estimates. Client contact experience essential. $12,000–$15,000. Long Island, N. Y. W-1004.

Assistant Chief Engineer, Production-Equipment Development, graduate mechanical or electrical, 25–45, minimum of five years applicable work background in either manufacturing engineering, process engineering, mechanical department, specialty machine manufacturing, or plant engineering. Must be familiar with electrical (resistance welding, controls) and chemical (lubrication, derusting) as well as strength in mechanical area. Company manufactures industrial steel link chain, arc-welding electrodes. $10,000–$12,000; moving expenses. Western Pa. W-1003.

General Parts Manager, graduate engineer, 35–45, some experience in service or repair parts department work in the automotive field. Should have some background in sales promotion and marketing in the transportation field. $12,000–$13,000. Ohio. W-993.

Director of Manufacturing Engineering, 40–45, 15 to 20 years' experience in heavy machine equipment design. Responsible for complete tooling. Heavy gage metal forming, stamping, piercing, and drawing as used in the automotive industry. $25,000. Midwest. W-989.

Chief Methods Engineer, graduate mechanical, young, to take complete charge of methods engineering in multiplant organization, to recommend and supervise installation of new equipment for woodworking. Some experience in wood processing helpful, but not a prerequisite. Open. N. Y. State. W-985.

Assistant Resident Engineer, mechanical or electrical graduate, to be responsible for installation of all electrical and mechanical facilities. $12,000 plus housing, Middle East. F-979(b).

Application-Proposal Engineer, mechanical or chemical engineering graduate, at least five years' experience in analysis and preparation of technical data of fans and compressors in industrial, power, or process fields. $9000–$12,000. Midwest. W-972.

Engineers. (*a*) Assistant chief engineer, mechanical graduate, minimum of ten years' design and design-supervisory experience on water or air-cooled compressors for pipeline, process industrial, or military fields. $12,000–$15,000. Midwest. (*b*) Senior design engineer, mechanical graduate, at least five years' design experience, including stress and vibration studies on fans, centrifugal or reciprocating compressors. $8000–$11,000. Midwest. W-971.

Product Manager, engineering graduate, ten to fifteen years' experience in product engineering, marketing, pricing, and sales of belt conveyers, idlers, and accessory equipment, to take charge of staff functions between sales, design engineering, and manufacturing. $12,000–$15,000. Midwest. W-970.

Methods and Mechanical Engineer, graduate mechanical or industrial, or civil with some methods experience; some background in the construction industry, specifically at construction sites. Must be familiar with custom and job-shop work in the metals trades, preferably in forming of sheet-metal fabrications of pipe, etc. Will be required to research, develop, and recommend improved methods for the shop fabrication and the field construction, installation of heating, ventilating, air-conditioning and plumbing systems, and to assist operating personnel in the installation; recommend improved methods for the use of tools and especially in materials handling of pipe, duct work, air conditioning, heating and plumbing fixtures and equipment, etc. $10,000–$12,000. Western Pa. W-964.

Senior Industrial or Production Engineer, 28–42, to work in Argentina for 12 months, survey current industrial plants, and make recommendations for new investment. $15,000–$18,000 a year; tax-exempt category, therefore salary is net. F-955.

Engineers. (*a*) Design engineer, experience on high-speed rotary vacuum pumps and similar machinery. Good opportunity for a capable man interested in all aspects of product management. $8400–$9600. (*b*) District sales manager on centrifugal pumps and heat-exchange equipment. Must be established and experienced sales administrator. $10,800–$12,000 plus bonus. Pa. W-947.

Plant Superintendent, graduate mechanical or electrical, minimum of ten years' supervisory experience at least five years' experience as plant superintendent or equivalent; experience in electronic or electromechanical manufacturing preferred. Will plan and direct operations of fabrication and assembly departments to meet production schedules. Operations involve machining and assembly of complex electronic vibration testing systems. Company pays fee. Conn. W-939.

Process Engineers, degree in mechanical or chemical engineering, four to five years' practical experience, rather than research experience, in the rubber industry. Must have ability to assume planning responsibility and carry projects through to practical recommended conclusions. Commensurate with education and experience background. Company pays fee. Conn. W-931.

Sales and Service Engineer, graduate metallurgical, chemical, or mechanical, 25–35, experience with heavy mechanical-process equipment desirable. Knowledge of mechanism and structures essential. Contact with engineering firms and utilizers of heavy capital processing machinery is preferred. Initially involves field-service work including mechanical service on process equipment. Some travel. $6000–$9000 plus fringe benefits. Headquarters, San Francisco, Calif.; western territory includes Calif., Wash., Ore., Nev., and Ariz. W-916.

Construction Executive, graduate mechanical or civil, knowledge of construction procedures, costs, labor production and construction personnel, both subcontractors and company employees. Will be responsible for setting up, directing, and co-ordinating field activity of subcontractors and company employees. Construction operations include shopping centers, supermarkets, industrial buildings. Open. Central New England. W-900.

San Francisco Office

Designer, Pressure Vessels, mechanical graduate, to design pressure vessels, heat exchangers, atomic products; design calculations; establish physical characteristics to meet specifications and code requirements of Navy. Must be U. S. citizen. $8400–$12,000. Employer pays fee. Wis. Sj-6673.

Plant Engineer, Electronic, mechanical-engineering graduate, about 30, five years' experience as plant engineer. Knowledge of production tooling in electronics and process equipment (high vacuum system, complex control systems), plant layout, maintenance. Prefer knowledge of design, fabrication tooling in electronics. For manufacturer of microelectronic components. $9000–$10,000. Company pays fee. San Francisco Peninsula. Sj-6635.

Sales Engineer, Heating, Ventilating, mechanical-engineering option, to 50, several years' solid selling of air-distribution equipment (fans, blowers, louvers, registers), for commercial, industrial, and public buildings; able to take off figures, bid, specify, and to work with architects, engineers, contractors, owners, users. For an established, multioffice manufacturers' representative firm. Salary incentive, expenses, car. San Francisco Bay area. Sj-6709.

Sales Engineer, Distributor, mechanical background; experienced; to sell optical equipment (microscopes) for research, labs; heavy machinery (rolling mills, presses, drills, printed circuits). Know machine hydraulics. Commensurate salary; employer pays half of fee. Bay area, developed territory (labs, industry). Sj-6702.

Research, Development Engineer, Instruments, Mechanical, five years' work experience; know optics, solve design problems, research and develop products using electromechanical systems in ultraprecision fields for nuclear research. Direct designers, juniors, and draftsmen. $800–$900. San Francisco East Bay. Sj-6698.

Test, Installation Engineer, Air Conditioning, graduate mechanical or equivalent, to 50, over five years air conditioning, refrigeration construction, and installation. Assist resident manager environmental control systems of minuteman sites; supervise engineers and inspectors, install, test manage. U. S. citizen. Open. Employer will discuss fee. Mont. Sj-6690.

Industrial Engineer, Machine Parts, graduate mechanical, for methods and operation planning for sheet-metal machine parts, precision mechanical assembly, ball-bearing application, and assembly techniques. Work place layout simplification, material handling, plant layout fabrication and assembly tool and fixture design, cost estimate, time standards, machine evaluation, and replacement studies. For a manufacturer. $750. San Francisco Peninsula. Sj-6704.

Estimator, Sales Engineer, Heating, Ventilating, 22–40, two years' experience in heating, air conditioning, plumbing minimum. Estimate, take off for plumbing, heating and air condi-

tioning, bid and sales. For a contractor. $650. Nev. Sj-6688.

Project Engineer, Refinery, Chemical, graduate mechanical or chemical, to 50; ten to fifteen years project; familiar with mechanical work, equipment-type plant. Work on refinery and chemical-process plants, manage project. Customer contact, responsible for project from start to finish. No field work. For a consultant. $900–$1200. Los Angeles. Sj-6650.

Field-Service Engineer, Process Equipment, graduate mechanical, metallurgical, or chemical, experienced with heavy mechanical-process equipment. Knowledge of mechanisms and structures. Field-service work with engineering firms and utilizers of heavy capital processing machinery. To service and assist district manager with grinding mills, rotary dryers, classifiers, feeders and related items used by mining, cement, ceramic, and industrial-mineral producers and industries. For a manufacturer. $6000–$9000. San Francisco. Sj-6611.

Quality-Control Engineer, Steel, graduate metallurgical, chemical, or mechanical, recent graduate or limited work experience. Assist in metallurgical quality control in shop and lab. For a steel mill. San Francisco area. Sj-6710.

Designer, Pumps, graduate mechanical; recent graduate to three years product design, development, applications on hydraulic pumping. For national manufacturer of standard, specialty pumping, and water systems (domestic, industrial, and irrigation). Open. San Francisco East Bay. Sj-6262.

Industrial Engineer, Bags, graduate industrial, recent graduate, to do bonus schedules, time-motion studies in large plant making burlap, cotton, and paper bags. $500. San Francisco East Bay. Sj-6668.

Industrial Engineer, Business, graduate industrial, several years' experience, preferably in paper-converting business, time studies, method improvements, handling, purchasing office, and plant-machinery layout. For paper manufacturer. $500–$650. San Francisco East Bay. Sj-6542.

CANDIDATES FOR MEMBERSHIP AND TRANSFER IN ASME

THE application of each of the candidates listed below is to be voted on after Dec. 26, 1961, provided no objection thereto is made before that date, and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and • Promotions

Alabama

Reid, James R., Birmingham
Wright, John H., Mobile

California

Charley, Philip J., Los Angeles
Hajek, Ernest E., Richmond
Hoffman, Samuel K., Canoga Park
•Hubalek, Vlad F., Alhambra
Mires, Raymond M., Long Beach
Siniscal, Paul D., San Francisco
Studebaker, Jack F., Hollywood

Connecticut

•Noell, Algernon, S., Jr., Windsor
Sokolski, Hubert G., New Britain

Delaware

•Shearer, William A., Jr., Wilmington

Illinois

•Vann, Robert W., Chicago
Watts, Thomas E., Chicago

Indiana

•Juncal, Raymond W., Fort Wayne

Iowa

Cook, Robert M., Ames
•Magalsky, Keith A., Dubuque

Louisiana

Doussan, Thomas H., Metairie

Maryland

Brown, William F., Baltimore
Steves, Howard K., White Oak, Silver Spring

Massachusetts

Garbus, Richard O., Springfield

Michigan

Andersen, Erik M., St. Clair Shores
Daringer, Ronald G., Rives Junction
Hamilton, John G., Southfield
Hsi, Hwei-Kai, Jackson
Visser, George G., Grand Rapids

Minnesota

Manthey, Robert W., Savage

Missouri

Cook, Alan R., Kansas City
Hughes, Robert H., Kansas City

New Jersey

Albano, John V., Bayonne
Burkart, Alex G., Medford Lakes
•Levy, Martin J., West Orange
Saxe, Fabyan R., Jr., Mountainside
Schottinger, John J., Plainfield

New Mexico

•Arthur, Bryan E., Jr., Albuquerque

New York

Butler, Donald H., Baldwinsville
Campbell, Robert H., New York
Fersing, Jan E., Poughkeepsie
•Fritz, Robert J., Schenectady
Greenfield, Stuart F., Staten Island
Hanby, Joseph R., Ilion
Hieber, Edwin G., Astoria
Hillesland, Kent L., New York
Jordan, Frank J., New York
•Joseph, Hans H., New York
Koprowski, Robert R., Rochester
Lux, Robert F., New York
Prasad, Hanumanthu R., Brooklyn
Steed, James B., Westbury
Steele, Maurice G., Rome
Vreeland, Howard C., Wellsville
Yu, John Yao-Tsou, New York

North Carolina

Ringer, Cecil D., Winston Salem
Wallace, Clinton R., Wilmington

Ohio

Batchman, Robert F., Cleveland
Cook, Walter F., Cincinnati
Doering, Donald R., Dayton
Dorr, Frank I., Jr., Columbus
Kramer, Vincent J., Kettering

Oklahoma

Stevens, Morris H., Tulsa

Pennsylvania

Bouvier, Anton J. F., Pittsburgh
Brubaker, James E., Pittsburgh
Cantagallo, Raymond E., Philadelphia
Coleman, Elmer W., Erie
Hess, Robert J., Bethlehem
Mitch, George C., State College
Ressler, Ronald R., Conshohocken

South Carolina

Oates, Francis M., Hartsville

Tennessee

Alexander, Robert A., Chattanooga
Reed, James H., Chattanooga

Texas

Claycomb, Jackson R., Houston
Fonville, Tash T., Taft
Glasscock, Melbern G., Baytown
Rundell, Herbert A., Bellaire
Storms, Charles G., Orange

Washington

•Pugel, James D., Seattle

West Virginia

Sesler, Robert W., Charleston

Wisconsin

Bell, Donald J., Oconomowoc
Richardson, Bobbie L., Milwaukee

Foreign

Gaballah, Helmi A. M., Cairo, Egypt, U. A. R.
Hussain, Syed N., Fenchuganj, Dist. Sylhet. E. Pakistan
Johnsson, Stig A. J., Vasteras, Sweden
Lau, Jark C., Singapore
Maguire, Dennis E., Ickenham, Middlesex, England
Platt, Kenneth H., Westminster, London, England
Schwederaky, George H., The Hague, Netherlands
Setty, K. A. Venkatarama, Rourkela, Orissa, India
Sinha, Kailash P., Dhanbad, Bihar, India
Waddington, Roy S., Toronto, Ont., Canada

•Promotion to Member or Affiliate.

OBITUARIES

Axel Herbert Ahlberg (1906–1961), owner, Gear Engineering Service Company, Burbank, Calif., died, July 15, 1961. Mem. ASME, 1957.

William Robert Ahrendt (1919–1961), visiting professor, National University of Engineering, Lima, Peru, died, Sept. 1, 1961. Assoc. Mem. ASME, 1946; Mem. ASME, 1953. Mr. Ahrendt was instrumental in the formation of several engineering companies during a successful career in business that made him a wealthy man before the age of 40. Two years ago, however, he began divesting himself of his business interests to devote more time to writing and teaching. A part time instructor at the University of Maryland's School of Engineering, he studied Spanish for a year before taking the university position in Peru.

In 1947, he formed his own automatic controls engineering firm in Washington, D. C., and within five years was grossing $2 million annually. He merged the firm with Litton Industries of California in 1955, becoming vice-president of the corporation. He and a partner later designed a lawn mower tractor and formed Copar, Inc., Laurel, Md., to manufacture it. He also organized Integron, a machine tool firm in Boston, Mass. He authored several technical magazine articles, contributed to the Encyclopedia Britannica, and wrote two books, "Servomechanisms Practice" and "Automatic Feedback Control." In 1954 *Fortune* magazine named him "one of the nation's outstanding young corporation executives."

Richard Joseph Bagdon (1920–1961), chief process engineer, National Seal Division, Federal Mogul Bower Bearings, Inc., Redwood City, Calif., died, July 16, 1961. Mem. ASME, 1957.

Robert Allen Banck (1915–1961), district manager, Riley Stoker Corporation, New Orleans, La., died, July, 1961. Mem. ASME, 1948.

William Aldrich Battey (1876–1961), retired, vice-president and director, Pennsylvania Crusher Company, Philadelphia, Pa., died, Jan. 27, 1961. Assoc-Mem. ASME, 1919; Mem. ASME, 1935.

Harold Sill Bell (1889–1961), consulting engineer, Summit, N. J., died, Aug. 25, 1961. Mem. ASME, 1950. Mr. Bell was a specialist in petroleum. He organized H. S. Bell, Inc., petroleum engineers, after World War I, and set up an affiliate company, Compagnia Tecnica Petroli, in Italy, in 1935. Early in World War II he was a special attaché at the U. S. Embassy in Rome, in charge of British interests. In 1942 he became a petroleum consultant to the U. S. Board of Economic Warfare, and was later assigned to the Joint Petroleum Board (Army and Navy) as a member of the mission to Australia to investigate the possibility of using Australian shale oils. He edited a Petroleum Transportation Handbook for the McGraw Hill Publishing Company, and authored "American Petroleum Refining" and "Oil Shales and Shale Oils," published by D. Van Nostrand & Company.

John Neal Cain (1884–1960), locomotive engine man, Pennsylvania Railroad, Philadelphia, Pa., died, May 18, 1960. Mem. ASME, 1942.

John Osborne Chesley (1884–1961), retired, manager, Aluminum Company of America, Pittsburgh, Pa., died, May 17, 1961. Mem. ASME, 1946.

Roy Reed Edwards (1927–1961), contracting engineer, Sales Division, Chicago Bridge & Iron Company, New York, N. Y., died, Aug. 22, 1961. Mem. ASME, 1960.

Charles Tyndale Evans, Jr. (1917–1961), vice-president, Universal Division, Universal-Cyclops Steel Corporation, Bridgeville, Pa., died, Feb. 8, 1961. Assoc-Mem. ASME, 1942. He was a member of the Joint ASTM-ASME Subcommittee on Effect of Temperature on Metals. During the war he developed a process for producing tungsten carbide armor-piercing shot. He wrote a number of technical papers on alloys for gas turbines.

Henry Donald Fisher (1882–1961), retired, treasurer, New Haven Pulp & Board Company, and consultant, Westcott & Mapes, Inc., New Haven, Conn., died, July 31, 1961. Assoc-Mem. ASME, 1907; Mem. ASME, 1914.

Lewis Rumsey Gaty (1902–1961), vice-president, engineering and research, Philadelphia Electric Company, Philadelphia, Pa., died, Aug. 29, 1961. Mem. ASME, 1948. A well-known nuclear scientist, Mr. Gaty was vice-president and trustee of the High Temperature Reactor Development Associates, Inc.; vice-president of the technical and engineering committee of Atomic Power Development Associates, Inc.; and a member of the technical and engineering committee of the Power Reactor Development Company. He was a director of the Philadelphia Power Company, the Susquehanna Power Company, and the Susquehanna Electric Company. He authored and coauthored several technical articles, one of which appeared in *Electrical World* in 1946.

Maximilian Meier Goldberg (1875–1961), retired engineer and inventor, National Cash Register Company, Dayton, Ohio, died, Aug. 23, 1961. Mem. ASME, 1921. Mr. Goldberg pioneered in machine concepts and held many patents.

James Francis Hunter (1876–1961), consulting engineer, Gas Utilities, New Rochelle, N. Y., and former vice-president of Consolidated Edison Company of New York, Inc., died, Sept. 8, 1961. Assoc-Mem. ASME, 1899; Mem. ASME, 1909.

Edwin Anton Kariba (1923–1961), design engineer, International Harvester Company, Chicago, Ill., died, Aug. 8, 1961. Assoc. Mem. ASME, 1950.

Clifford Barnes Langstroth (1884–1961), consulting engineer, Plainfield, N. J., died, May, 1961. Assoc-Mem. ASME, 1912; Mem. ASME, 1919. He wrote several technical articles in the welding field. Mr. Langstroth started the welding of frames for diesel electric locomotives, and developed and patented a covering for welding wire. He supervised the welding of the Delaware & Hudson Company welded locomotive boiler, the first in the U. S. A., and invented a positioner for the work.

Frank C. Meyers (1903–1961), engineering superviser, Consolidated Western Steel Division, U. S. Steel Corporation, Los Angeles, Calif., died, Aug. 5, 1961. Mem. ASME, 1956.

Herbert Fisher Moore (1875–1961?), retired research professor of engineering materials, Emeritus, University of Illinois, Urbana, Ill., died recently according to a notice received by the Society. Mem. ASME, 1913. His contributions to research include investigations in fatigue of metals and developments of special types of testing machines for strength of materials. To engineering literature he contributed 25 bulletins as well as circulars and other reports at the University of Illinois Engineering Experimental Station, and more than 100 major articles published in various technical magazines. He was coauthor of the book, "The Fatigue of Metals," 1927; "Materials of Engineering," published in the first edition in 1917 sections on materials in "Merriam's Handbook," and in the "Standard Electrical Engineer's Handbook," and the "Manual of the Endurance of Metals Under Repeated Stress." He was a past-president of ASTM.

Gordon Murphy (1912–1961?), vice-president in charge of manufacturing, Foote Brothers Gear & Machine Corporation, Chicago, Ill., died recently according to a notice received by the Society. Mem. ASME, 1943.

Eugene Walter Murray (1882–1961), retired, district sales representative, The Spencer Turbine Company, Hartford, Conn., died, Aug. 27, 1961. Mem. ASME, 1943.

Lee Nusbaum (1879–1961?), owner, Pennsylvania Engineering Company, Philadelphia, Pa., died recently according to a notice received by the Society. Mem. ASME, 1917. Mr. Nusbaum was associated with the company since 1905, and designed and installed refrigerating plants throughout the U. S. A., South America, and Cuba. He held several patents and wrote articles on refrigeration for various magazines.

John Edward O'Brien (1909–1961?), assistant engineer, Pacific Gas & Electric Company, San Francisco, Calif., died recently according to a notice received by the Society. Assoc-Mem. ASME, 1944; Mem. ASME, 1949.

James Kenneth O'Neill (1912–1960), chief inspector, Engineering Division, Hartford Steam Boiler Inspection & Insurance Company, Hartford, Conn., died, October, 1960. Assoc. Mem. ASME 1954.

Richard Edwin Opdyke (1930–1960), engineer, Electric Boat Division, General Dynamics Corporation, Groton, Conn., died, Feb. 11, 1960. Assoc. Mem. ASME, 1956.

Matthew William Potts (1896–1961), materials handling consultant, New Rochelle, N. Y., died, June 25, 1961. Mem. ASME, 1942. Mr. Potts wrote articles on materials handling equipment for a number of magazines, and formerly was associate editor of *Industrial Management* and materials handling editor for *Distribution and Warehousing* magazine.

James Dudley Skinner (1872–1961?), retired, president, Fuller & Company, Inc., Bridgeport, Conn., died recently according to a notice received by the Society. Mem. ASME, 1915.

Alfred John Thalman (1918–1961), secretary, The Clark Controller Company, Cleveland, Ohio, died, May 21, 1961. Assoc-Mem. ASME, 1942.

Carl Waldemar Vail (1893–1961), plant engineer, Adding Machine Division, National Cash Register Company, Ithaca, N. Y., died, July 20, 1961. Jun. ASME, 1919; Assoc.-Mem. ASME, 1924; Mem. ASME, 1935.

John E. A. Warner (1892–1960), retired, chief engineer, Robert Gair Company, Inc., now Continental Can Company, Inc., New York, N. Y., died, Oct. 17, 1960. Assoc-Mem. ASME, 1920; Mem. ASME, 1935.

Erwin Elmer Wood (1870–1961), retired, owner, E. E. Wood Machinery Company, Detroit, Mich., died, Aug. 14, 1961. Mem. ASME, 1900.

Ralph Allan Yaeger (1925–1961), senior engineer, Sverdrup & Parcel Engineering Company, St. Louis, Mo., died, June 7, 1961. Mem. ASME, 1959.

YARWAY news briefs

from **Yarnall-Waring Company,** *Philadelphia 18, Pa.*

BRANCH OFFICES IN 19 UNITED STATES CITIES • SALES REPRESENTATIVES THROUGHOUT THE WORLD

HOW YOU CAN SAVE MAINTENANCE...INCREASE OPERATIONAL TIME WITH YARWAY COLOR-PORT GAGES

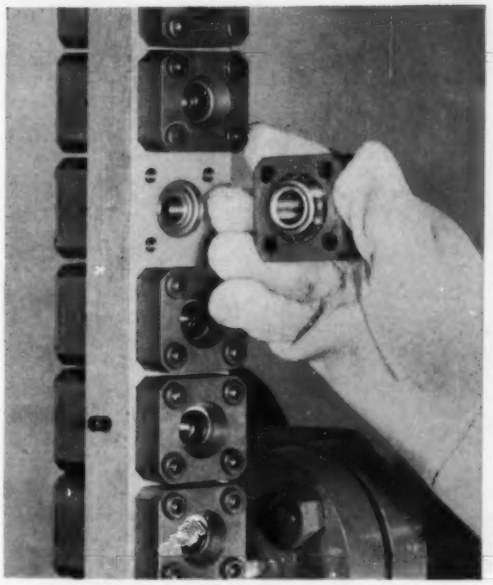
Two big problems confronting the operators of high pressure boilers—excessive maintenance and frequent downtime of water level gages—can be solved with new Yarway Color-Port Gages.

These Color-Port features will help you do the job:

- Patented spring loading of individual port covers, maintains proper pressure on glasses and gaskets at all times.
- Maintenance work can be done *with the gage in place.* NO TORQUE WRENCHES NEEDED!
- Individual "package" port assemblies (glass-mica-gasket) can be replaced in a few minutes.

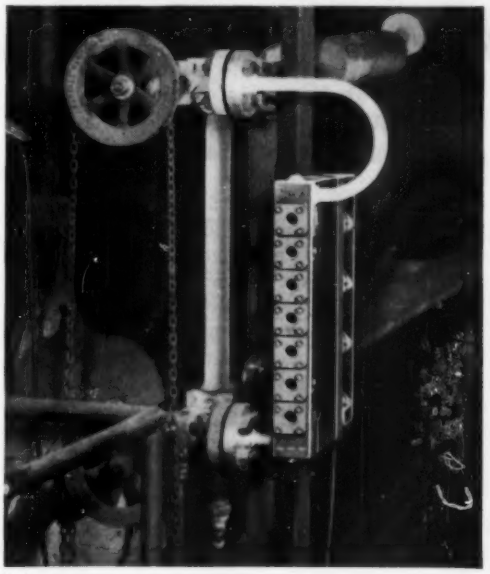
These benefits, PLUS brilliant two-color readings (water space shows green; steam space shows red), PLUS Yarway quality—make COLOR-PORT your best gage buy! Available for all pressures from 0 to 3000 psi maximum.

Write for Yarway Bulletin WG-1815.

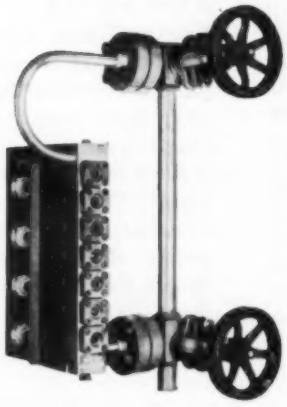


Servicing the Yarway Color-Port Gage is simple! Just remove 4 cap screws (no need for torque wrench), place new "package" assembly in cover, and replace cover assembly. A matter of two or three minutes.

Yarway Color-Port Gage installed on boiler at Alan Wood Steel Co. Leading industrial plants all over the country as well as many major utilities are among the hundreds of satisfied Color-Port Gage users.



NEW COMPACT DESIGN WITH "WELBLOC" VALVES SAVES INSTALLATION SPACE

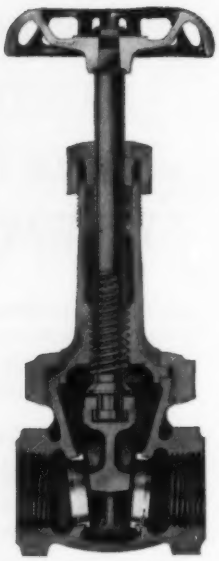


New "Welbloc" valves on Yarway Color-Port Gages reduce installation space requirements up to 40%. All working parts of valves are easily accessible. Improved direct flow from boiler drum to gage, reduces temperature differential.

Circle No. 142 on Readers' Service Card

Look into 2 things...

to slash maintenance costs of MONEL SEAT Bronze Gates



What is the RELATIVE HARDNESS of the Wedge and the Seat Rings?

If the bronze or nickel alloy wedge is less hard than the monel seat rings, the wedge will wear. That is GOOD... with the wedge taking the wear, the seat rings will NOT wear, at least, not enough to worry about. So, you avoid the costly, time-consuming task of replacing seat rings or valve body. It's a cinch to replace a worn wedge... merely slip off the old wedge and slip on the new.

How are SEAT RINGS SECURED in the body?

A seat ring leak in a Bronze Gate Valve means big trouble and expense! To avoid it, be sure there is no possibility of seat rings loosening, shifting or deforming. Permanent, all-around support is the only sure protection and to provide it Jenkins expands (flares) seat rings into the body by a special process. This becomes practical when the wedge takes the wear and seat rings last for years and years. There's no need to replace seat rings.

JENKINS HAS THE ANSWERS

— to simpler, lower-cost maintenance. Jenkins gives you a wedge that takes the wear to save the seat rings. Jenkins expands seat rings into the body. These are only 2 of the money-saving features of Jenkins MONEL SEAT Bronze Gates and other types of bronze gate valves stocked by your local Jenkins Distributor.

WRITE FOR FOLDER 181-C which gives complete information about all Jenkins Bronze Gates. Jenkins Bros., 100 Park Avenue, New York 17.

JENKINS VALVES

JENKINS SINCE 1864

Jenkins Bros

Circle No. 73 on Readers' Service Card

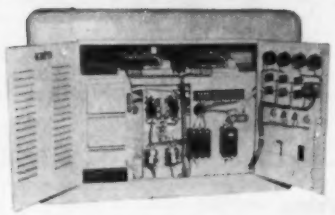
MOST TRUSTED TRADEMARK IN THE VALVE WORLD

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Available literature or information may be secured by using convenient Reader Service Card on Page 17

NEW EQUIPMENT



AC-DC Motor Generator

An unusual stabilized power source is Kato Engineering Co. motor-generator set which can supply both 120/208-volt, 400-cycle alternating current and 20 to 30-volt direct current at the same time. Input is provided by a 20-hp, 550-volt a-c, 3-phase, 60-cycle, 1714-rpm squirrel-cage-type induction motor. Output generator is 10-kw, 12.5-kva, 120/208 volts a-c, 3-phase, 400-cycles, 1714 rpm, with a direct-connected exciter. Also, mounted on the same shaft is a 2-kw, 20 to 30-volt, 100-amp d-c generator. The fully housed unit is mounted on a skid-type base. A static regulator on both the a-c and d-c generators is capable of voltage regulation of 2 per cent from no load to full load. Harmonics are under 5 per cent.

—K-1

Welding Fittings

A new line of welding fittings has been announced by Taylor Forge & Pipe Works. These fittings, known as the Taylor Forge Compact Line, have been expressly developed to reduce cost in welded heating and cooling-system piping and similar moderate and low-pressure welded lines.

For greater manufacturing economy, the line has been compacted down to the sizes and types of fittings usually required for heating-cooling piping: 90 and 45 deg elbows, straight and reducing tees, concentric and eccentric reducers and caps in sizes 2, 2½, 3, 4, 5 and 6 in. reducing tees and reducers with reductions in the intermediate IPS sizes down to one half of run or large end size. Ends are accurately sized in thicknesses to match corresponding sizes, and thicknesses, of Schedule 40 pipe. All are seamless and made only in Grade B carbon steel.

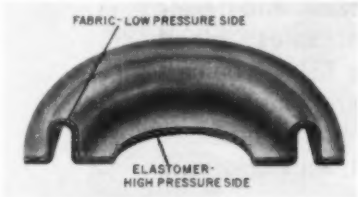
The fittings are arbitrarily designated as Class 125 (WOG rating, 175 psig; saturated steam rating, 125 psig). —K-2

Slush Pump

An improvement in the National H-1250 power slush pump, standardizing weldment of forgings in the fluid end, is being introduced by National Supply Div. of Armco Steel Corp., in its largest pump. Forged-steel valve pots are welded to forged-steel fluid-cylinder bodies and joined together with a cast-steel discharge manifold by specially-designed automatic, submerged-arc welding equipment to make a homogeneous steel unit. The suction manifold, also a steel casting, is bolted to the weldment. Use of precision controls on welding equipment, stress relief after welding, and complete X-ray inspection of all weld metal assure welds stronger than the parent metal. All units are hydrostatically tested at 8000 psi.

Forgings in the fluid end of this 1250-input-hp slush pump increase strength and soundness in areas that are subjected to the greatest fluid stresses. The forged steel gives maximum resistance to fatigue and minimizes field maintenance.

With welded construction, the H-1250 fluid end has been given both fabrication and performance advantages matching those of the welded main frames of National slush pumps. The frames are fabricated by welding together steel plates, structurals, and steel castings. —K-3

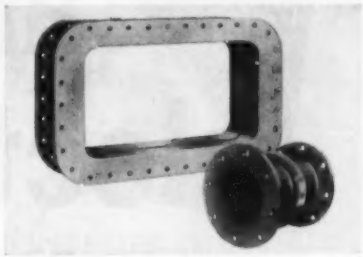


Long-Stroke Diaphragms

Diaphragm Industries, Inc. announces a line of long-stroke, elastomer diaphragms. These unique friction free, rolling type diaphragms are designed and engineered to provide an effective pressure area which remains constant throughout its stroke.

Working with a specially compounded range of elastomers of the buna N, neoprene, GR-S, butyl, silicone, Hypalon, polyurethane, Viton, and fluorinated silicone variety, the company is producing diaphragms that are virtually leakproof, have low permeability characteristics and can be used with an almost infinite range of fluids and gases.

Low-pressure diaphragms (without fabric), plus high-pressure diaphragms (with fabric) are offered. The high-pressure type incorporate fabrics; such as dacron, nylon, teflon, glass, or similar materials depending upon the particular environmental and operating characteristics. —K-4



Rubber Expansion Joints

Crane Packing Co. is offering a complete line of rubber expansion joints to industry. Made from a specially developed, high-grade abrasion-resistant rubber that has been compounded for maximum flexibility and nonset characteristics, they are suitable for a wide range of applications. Joints are reinforced with heavy-weight duck to give extra toughness and service and are coated on the outside with neoprene to prevent oxidation or damage from oil or grease. Joints are also available with an internal neoprene lining or are made from neoprene throughout.

Standard spool-type joints are available for pipe sizes from 2 up to 72 in. Vacuum-type joints are designed for 30 in. of mercury, and pressure-type joints for 0 to 150 psi, depending on size. Special joints can be designed in tapered, rectangle, oval, or other shapes and for acids, gases, chemicals, and so on.

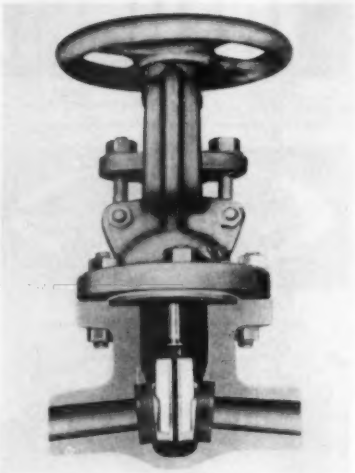
—K-5

Spray Gun

Spraying Systems Co. has introduced the No. 6960-22 GunJet spray gun for use with cleaning and degreasing solutions. The gun provides a low-capacity hard-hitting spray, with sufficient impact to remove dirt or penetrate built-up films. A feature of this design is that effective cleaning is obtained with economical use of cleaning solutions. Where required, rinsing may also be done with a minimum use of water. The spray gun operates pneumatically providing efficient operation at air pressures of 20 to 100 psi. Liquid is drawn into the gun through siphon action. Liquid capacity of the gun can be varied by loosening the knurled lock ring located immediately in front of the forward (liquid) inlet and rotating the extension tube to the desired setting. The gun is equipped with a quality trigger control assembly and trigger lock for easy, dependable operation. The complete spray gun is 14-in. long providing a compact convenient size for handling and weighs only 14 oz. Write for Data Sheet 6960-I and Bulletin 87. —K-6

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS



Valves

"Bi-Valve," recently introduced by Chapman Valve Mfg. Co., features self-conforming positive-seating and absolute shut-off. Bi-Valves are designed around a swivel principle which permits the disks to conform individually to seat faces even with severe pipe strain or distortion because of temperature swings. Made of steel, Bi-Valves come in sizes from 2 in. up in all pressure classes. These valves have the inherent flow efficiency of gate valves and absolute shut-off ability hitherto thought to be exclusive in globe valves. Thus, where globe valves have been preferred in certain applications, it is now possible to use smaller pipes, valves, and fittings in many areas in chemical, petroleum, power and marine applications. Under special conditions, single Bi-Valves are being used successfully in place of double valving. **—K-7**

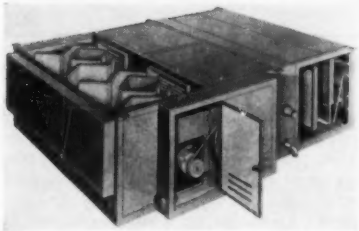
Hot-Water Boilers

Cleaver-Brooks Co., has announced the commercial availability of a complete line of small, compact, gas-fired, hot-water boilers. Named the Beaver, the line consists of 16 sizes ranging in capacity from 200,000 to 3,000,000 Btu/hr. The boiler can supply hot water for building heating, for hot service water, for heating swimming pool water, and for year-around heating and air-conditioning systems. Vertical coils can be added to handle the variety of applications.

The Beaver boiler is extremely durable with an attractive and sturdy cabinet of 18 gage steel with the base 14 and 12 gage. The boiler more than meets the strict requirements of the ASME Boiler Code, the stress and capacity tests of AGA, and the strict rulings of the leading boiler insurance firm, Hartford Steam Boiler and Insurance Co. In Canada, the boiler is approved by the CGA and other approval bodies. **—K-8**

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS



Auditorium Ventilator

An auditorium unit ventilator, the Herman Nelson Audivent has been introduced by American Air Filter Co. Available for steam, hot water or electric applications, the Audivent has incorporated all of the important characteristics of the already successful Herman Nelson classroom unit ventilators in sizes to suit applications in the more public areas of a school such as the auditorium, gymnasium, cafeteria, swimming pool and so on. It can be simply converted to either immediate or future all year air conditioning.

An outstanding feature of the Audivent is its ultraquiet operation. Reducing noise levels to a minimum, Herman Nelson has pre-engineered the Audivent for specific air volumes with only minor variations in fan speed to adjust for variable resistances. A sound attenuator has been added to each unit and it is lined with 1-in-thick glass-fiber insulation bonded with a thermosetting plastic resin. Scientific design and placement of the baffles provides 12–18 sq ft of absorption surface for each 1000 cfm.

Absorption surface is of a density so as to achieve a noise reduction coefficient of 0.70–0.80 in the range of 125 to 4000 cps.

Another feature of the Audivent is the enclosed motor and drive. They are now within the cabinet and are readily accessible through hinged access doors. Since the motor and drive are both protected and out of sight, the unit is suitable for installation in occupied areas with no possible danger of hands or clothing being caught by moving parts. **—K–9**

Split-Case Pumps

An expanded line of split-case horizontal building trade pumps, trade named the "AquaLine" has been announced by Peerless Pump, Hydrodynamics Div., FMC Corp. (formerly Food Machinery and Chemical Corp.)

Produced with either a mechanical shaft seal or chevron packings, the AuaLine is now available in both types in a size range of $1^1/_2$ to 8 in. discharge. Capacity of the packed-type pumps is 2600 gpm with a 280-ft head range. Temperature range is 250 F. In the sealed type, the capacity is 750 gpm (at 3500 rpm) and 2600 gpm (at 1750 rpm). Head range is 350 ft (at 3500 rpm) and 280 ft (at 1750 rpm). Temperature limit in the sealed-type AquaLine is 225 F. **—K–10**

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Finned Tubes

The Griscom-Russell Co. has introduced large-diameter K-Fin tubing which is designed especially for use in the convection sections of furnaces heating petrochemicals or hydrocarbons for processing; waste-heat boilers; for tank heating and other fired and unfired applications. These tubes provide ten times or more outside surface area per foot of length than plain bare pipe or tubing, increasing the capacity of the furnace, the efficiency of the furnace, or both.

The helical fins are wrapped tightly into grooves plowed on the outside of the tube or pipe. The metal displaced by the grooves is then forced tightly against the sides of the fins by a patented, proven process to form a tight metal-to-metal bond. These finned tubes and pipes are suitable for any service for which bare pipe or tubing is satisfactory; available with carbon-steel, stainless or alloy fins, on carbon steel, stainless or alloy pipe or tubing. One to six in. diam pipes or tubes; with from 2 to 8 fins to an inch, meet a wide range of operating requirements.

—K-11

Speed Reducers

Production of two new series of horizontal speed reducers has been announced by Falk Corp. Parallel shaft, Type Y, with ratios 1.84 through 292 to 1, and right angle, Type YB with ratios 5.06 through 1207 to 1. Capacity ranges from 9000 to 1,570,000 lb-in. torque, in cataloged, standard units (higher in custom units) with 22 standard sizes for each type, permitting precise and economical selection. Gears are single helical (98½ per cent efficiency per gear mesh under full load) with precision-cut, extra-depth, high-pressure-angle tooth form for greater capacity and increased strength. Heavy-duty double-ended shafts can be turned 180 deg for double gear life, and have large diameters to accommodate maximum torque and overhung loads. Rugged housings have smooth flat surfaces for simple mounting of motor brackets, backstops, brakes, and other modifications. Continuous positive lubrication is provided, with oiltight, dust and waterproof-type shaft seals, and automotive-type dip stick for easy oil check. —K-12

Wound Field Motor

Type GR wound field d-c or a-c/d-c universal motors of Globe Industries Inc., are 2¼ in. diam and range in length to 4⅜ in. They provide continuous-duty ratings up to ⅛ hp at 8000 rpm, and may be wound for series, split series, shunt or split-shunt operation. Windings are custom designed to deliver the optimum performance characteristics desired, and to meet appropriate MIL specifications. They are primarily used where minimum size and weight coupled with very high output torques are desired.

Type GR motors may be fitted with an integral d-c brake. A speed governor may also be supplied. Gear reducers can be furnished with the motor alone or with either the governor or the brake. Weight of the motor ranges from 1.5 lb in the short stack to 2.2 lb in the long-stack version. Mounting is by four bolts through the mounting flange. Several standard output shafts are available including a standard number 1 Woodruff key and a standard 13 tooth 20-deg PA pinion. —K-13

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Sintered Electrical Copper

A powder-metallurgy process for pressing and sintering copper has been developed that cuts the cost of electrical-grade copper parts by an average 10 per cent compared to extrusions or forgings. The process has been perfected by the Electrical Contacts and Specialties Div., Fansteel Metallurgical Corp.

Electrical conductivity of the sintered copper parts is 93 per cent that of wrought copper. Hardness is 80 RF compared to 87 RF for hard-wrought copper. Tensile is 39,000 psi, compared to 45,000 psi for hard-wrought copper and 33,000 psi for soft-wrought copper. Yield is 36,000 psi compared to 40,000 psi for hard-wrought copper.

While typical savings of 10 per cent have been achieved in pilot runs, actual savings depend on the amount of machining, material and labor in the comparable extruded or forged part. Length of run determines savings, also. **—K-14**

Variable-Displacement Pumps

Oilgear Co. is building a complete line of type DV heavy-duty, two-way variable-displacement pumps with electrohydraulic servo-operated controls. Any number of variable low-level (5 watts or less) electrical input signals from remote positions, can accurately and proportionately vary the rate of pump flow from either directional port. The Oilgear single-stage, Swing-Plate type, servo control valve directs low-pressure fluid to or from stroker to vary pump displacement from zero to maximum in 0.15 sec on small units and in 0.25 sec on large units. Strokers with smaller cylinders for higher pilot pressure to reverse maximum flow in large pumps in 0.10 sec are available. Extremely slow, precisely timed acceleration and deceleration rates up to 3 min, or even slower, can be provided.

Oilgear type DV pumps range in sizes from 13 to 169 gpm for pressures up to 1350 psi and from 5 to 108 gpm for pressures up to 2050 and 3000 psi. **—K-15**

Air Bearings

Air bearings for satellite simulators, consisting of spheres and matched seats or sockets, are available from Industrial Tectonics, Inc. The term "air bearings" is used because the spheres actually float on a film of air to simulate the weightless and frictionless conditions of outer space.

Sphericity of bearings up to 12 in. diam can be held to 0.000050 in. or less with surface finish of 4 microin. or less. Other tolerances can be held consistent with requirements of matching the sphere to bearing socket. The socket has a number of air vents so that when sufficient air pressure is supplied the sphere floats on a film of air. Nitrogen or other gases may be used instead of air. A table is mounted at the top of the floating sphere. The firm can make any practical size bearings and sockets to specifications. **—K-16**

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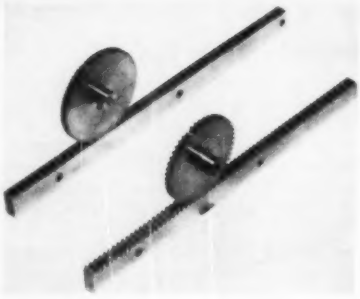

Precision Racks

To meet the increased demands for high-accuracy racks, PIC Design Corp., offers, from stock, a complete line of "Certified" precision spur gear racks, in 24, 1/16, 32, 48, 64, 72, 80 and 96 diametral pitch sizes.

Standard 11-in. lengths, precision ground on all sides, are available in PIC precision 1, 2 and 3 classifications. With ends ground to 1/2 linear pitch, racks may be butted, where greater lengths are required. Positive dimensional control may be obtained by the use of PIC gage blocks or measuring wires. —K-19

Heat Exchangers

The Brown Fintube Co., manufacturer of double-pipe and bundle heat exchangers, continues its product improvement program, by offering completely preassembled and pretested double-pipe hairpin heat exchangers.

Brown Fintube's heat-exchanger production specialists now furnish double-pipe sections in assembled units bolted together and manifolded to the cutomer's specifications. Furthermore, all units are given hydrostatic tests to insure satisfactory on-the-job operation. At the plant site, foundations can be erected and piping prefabricated so that a heat exchanger can be on stream in minutes after delivery to the job. —K-17

O-Rings

A patented Garlock Inc., product, Style 9593, Teflon slotted O-rings, offers a solution to difficulties encountered with solid Teflon O-rings. Rubber O-rings can be replaced with Style 9593 without altering the groove size.

The Teflon slotted O-rings are claimed to offer these advantages: Fit standard AN grooves, improve automatic sealing action, easier to install, lower friction, ideal for use against nonflammable hydraulic fluids, solvents, acids and other fluids. Complete information in Bulletin AD-157. —K-18

D-C Torque Motors

Aeroflex Laboratories Div. has developed a TQ series of D-C torque motors representing a significant advance in electromagnetic rotary power devices. It is available in various sizes, capable of delivering from 3 oz-in. to 75 ft-lb torque. No commutation is required. This unique design features infinite resolution because the positional effects of slot lock have been eliminated. Linearity tolerances (torque output versus input current) can be attained up to ±1.0%.

The series offer distinct advantages over conventional torque motor and motor gear train designs. Mechanical isolation between the driving and driven member reduces feedback, friction loads, and provides a virtually unlimited life expectancy for the torquer. No commutation required eliminating attendant maintenance, explosion, friction, and radio noise problems. Featured also is high torque to power input ratio, high torque to weight ratio, and full military environmental qualification. No power is dissipated in a "fixed field phase" when no torque is delivered. Peak torque capacity is three times continuous duty torque.

A complete line of amplifiers is available to drive these torquers. —K-20

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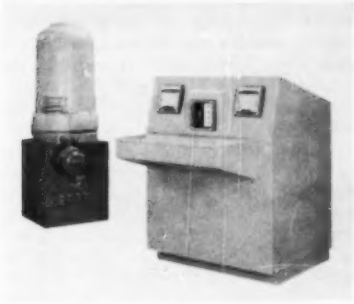

Process Steam Analyzer

Featuring trend readout display for compatibility with automatic control, a chromatographic analyzer made by Foxboro Co. provides measurements of up to six components on which to base control of process stream composition. Continuous measurement trends are monitored by two pneumatic recorders, each logging the concentration of three components. Sharp peak definition has been achieved largely thorugh a unique sampling valve which delivers a uniform slug of sample gas to the column for each analysis. A special annular slide is spring loaded to prevent carrier gas from leaking into the sample, keeping time lag and dead space to a minimum.

All timing functions are initiated by a metal belt in the programmer. Driven by a synchronous motor, the belt has actuators clipped to each side that not only operate the sample valve, automatic zero and column switches, but also select the correct recorder pen.

The programmer and trend recorders are housed in pull-out chassis and mounted in a console or existing panel remote from the analyzer. Available at the programmer are switches for injecting standard samples and running chromatograms; also individual component attenuators. **—K-21**

Airfoil Fans

Trane Co. has developed a line of 12-blade airfoil fans featuring a new blade design, improved inlet-cone and wheel-rim design, plus a new type of air cutoff. These features have resulted in a maximum of 91 per cent total efficiency rating for the line.

The Trane airfoil blade has a slight camber and a blade thickness that is 12 per cent of the blade's chord. This relatively thick blade contributes to higher fan efficiency, Trane says. Over a hundred different blade sizes and shapes were developed and tested before the final design was determined.

Class I and II fans are available in wheel diameters of 24 to 89 in. Class III fan wheels range from 24 to 73 in. All Trane airfoil fans carry the AMCA certified rating seal. Request Bulletin DS-348. **—K-22**

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Spherical Milling Machine

Designed for rough-milling precision full-end and truncated spheres prior to finish-microhoning, the spherical milling machine developed by Micromatic Hone Corp., for a prominent automobile manufacturer is used in a fast, two-operation technique for processing partial-sphere-type parts. Special tooling and fixturing techniques assure the uniform surface speed required for consistent quality and low unit cost.

The machine incorporates a specially developed, integrated hopper-loader system for fast, repetitive parts loading that saves 20–25 per cent in floor space over the independent loading arrangement formerly used, reduces loading time per part from 4–5 sec to only 1 sec, and increases gross productivity from 240 parts/hr to 260.

Another improvement built into the unit is the sizing control system, which consists of an automatic size checker, a feedback control, and a tool compensator control. Automatic gaging and tool compensation eliminate the need for spot checking by the operator. Also, no time is lost in gaging, as this is performed while the next part is being machined. —K–23

Air Filters

A line of Automaze Model HD heavy duty, automatic air filters has been introduced by the Air-Maze Div. of Rockwell-Standard Corp., for use on installations such as air intakes of large gas turbines in stationary power plants and similar applications requiring uninterrupted service over long periods with little or no maintenance.

Model HD Automaze oil-wetted filters, in rated maximum capacities from 3720 to 130,500 cfm based on a net effective filter face velocity of 450 fpm, are fully guaranteed against oil carry-over. They may also be used at the standard rated velocity of 505 fpm, with maximum rated capacities of from 4166 to 146,160 cfm.

The cabinets range in size from approximately 5 ft × 5 ft to 27 ft × 15 ft, with all cabinets nominally 2 ft deep. Powered by a heavy-duty polyphase 60-cycle motor driving through a double reduction worm gear reducer, the Automaze units may be adjusted to cycle, as required by the application. —K–24

Relays and Contactors

Four, low cost, 30-amp relays and contactors for noninductive loads are now available from Automatic Switch Co., designers and manufacturers of ASCO solenoid valves and Electromagnetic control.

Well suited for use in electric heating and lighting, they feature quiet operation, wiping contacts, laminated frame operators and high contact pressure. They are contact rated at 30 amp, 250 volts alternating current and may be applied continuously up to their full rating, open or enclosed, with conservative temperature rises. —K–25

Venturi Scrubber

Buell Engineering Co. has announced a venturi scrubber for separating entrained solids from high-temperature gases in the iron and steel, nonferrous metals, mineral products, fertilizer, pulp and paper, chemical and related fields.

The Buell scrubber is manufactured under an exclusive U. S. license from Waagner-Biro, Austria, and offers advantages of low pressure drop and low water requirements. These in turn result in lower power requirements and lower operating costs. Although the scrubber is new in this country, it is in use in continental Europe, Great Britain and in Japan. The first U. S. application will be in removing entrained solids from steel-mill exhaust gases.

The scrubber is unique in that it subjects the exhaust gases to a double scrubbing action as they pass through a bank of venturis. At each venturi a nozzle sprays a cone of water into the belled venturi entry and the gas receives its first scrubbing as it passes through this wall of spray.

It receives its second scrubbing within the venturi as it passes through a second inverted cone formed as the water rebound from the belled mouth into the throat of the venturi. This deflection of the water decreases its velocity and breaks it into smaller droplets. While this takes place, the velocities of the gas and entrained solids are increased, due to the narrowing throat of the venturi. Thus, the faster moving gas stream passes through the slower moving water spray and is subjected to the second scrubbing action. The scrubber cleans gases of dust particles as small as 0.05 microns at efficiencies of 99 per cent plus. —K–26

Packaged Compressor

Clark Bros. Co., Div. of Dresser Industries, Inc., has announced Model CFB-4 which extends to 750 bhp the horsepower range of the Clark CFA-CFB packaged field compressor line. Incorporating design and construction features that have been proved in more than 200 such units, the compressor is designed for heavy-duty applications where greater capacity and one to four stages of compression are required.

Built-in sizes from 400 to 750 bhp, the CFB-4 uses a 5-in-stroke, four-cylinder, balanced/opposed compressor with extra heavy case and running gear to accommodate the higher loading. A completely self-contained compressor station, the unit can be used for gas lift, gas boosting, repressuring, pressure maintenance, field gas gathering, pipeline testing, and air drilling. Operating at 1000 rpm, the compressor is directly connected to an oil field type engine by flexible type coupling. Belt and gear drives are eliminated. —K–27

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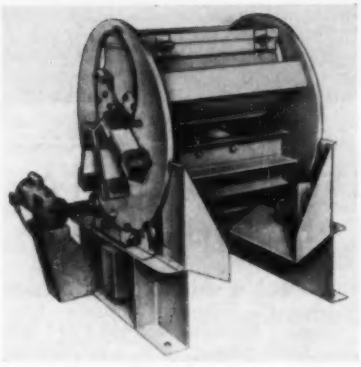

Barrel Finishing Machine

A vibratory barrel finishing machine, Model VB-6, with new design, increased capacity, and push-button operation, has been introduced by Syntron Co.

The unit, with a capacity of 6 cu ft, deburrs, deflashes, polishes or descales and includes a push-button feature for rinsing or unloading. It finishes parts completely, rotates to the emptying position, and then the barrel tilts in order to facilitate unloading—all automatically.

The electromagnetic drive produces 3600 vibrations per min which is more than adequate to keep both parts and abrasive media working 100 per cent of the time. Both heavy and light-gage metal, odd stampings, shielded areas and recesses are brought to a high degree of finish. There are no cams, belts, gears, bearings or other moving parts in the drive to cause troublesome maintenance. More information in Bulletin No. 82261. **—K-28**

Groove Gage

A dial indicator groove gage is now available from the Adam Tool Co. This gage is designed for production measurement of O-ring, snap-ring, and similar internal grooves.

A unique feature of this gage is a set of extension arms which enables the same gage and the same measuring tips to be used for grooves in deep bores and for grooves in shallow recesses.

In order to ensure efficiency in use, the weight of the gage has been minimized by a compact design and an aluminum body. For long wear and for accuracy, the gaging tips and other critical parts are made from hardened and ground tool steel. The indicator is nested in and protected by the gage body.

Five standard gaging tips cover the range of O-rings from 6227.3 to 6227-52 and snap rings from 50 to 500. With extensions the gage can be used to measure grooves inside a bore $6^{8}/_{16}$ in. deep. **—K-29**

Relief Valves

A single-seated, spring-loaded, diaphragm-actuated relief valve has been announced by Atlas Valve Co. This No. 1910R, Type E, relief valve is designed for gas, oil and water service. The body is cast iron with nickel-alloy or stainless-steel trim.

No. 1910R meets requirements for a tight-closing relief valve for pressures up to 300 psi. Features include renewable valve disk and O-ring construction that eliminates stuffing boxes and reduces maintenance to a minimum. The valve will give long service with liquids at temperature below 180 F.**—K-30**

Reports of ASME Research Committee on Fluid Meters

Covering the theory and use of fluid meters, fluid measurement, and computing flow rates.

FLUID METERS
Theory and Application

This report establishes a clear understanding of fluid meter knowledge of various meters, their coefficients and general behavior. **It**

- contains the classification and nomenclature of fluid meters as used throughout reports together with the definitions of special terms and other general information,
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A guide for making fluid measurements of the quality such as required in an acceptance test. For the square-edged orifice, flow nozzle, and Venturi tube, **this report presents**

- best available information on the construction and installation of these three most extensively used types of differential head metering units,
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- examples of the application of typical data,
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PTC—19.5 ; 4 **Pub. 1959** **$5.00**

FLOWMETER COMPUTATION HANDBOOK

A NEW report of inestimable value to all users of flow metering equipment.

Here is presented a simplified and practical method by which the engineer can design a sharp-edged orifice, a flow nozzle, or a Venturi tube suitable for the measurement of a specific quantity of steam, water, oil, gas, or any other fluid transported in a pipe line. Or, by using a given size orifice, nozzle, or Venturi tube he can compute the resulting flow quantity within the usual commercial accuracy. Should he require the maximum practical accuracy in his primary element design, or in his flow quantity calculations, he can refine his simplified calculations by the addition of a few suitable correction factors. **In this handbook**

- each of these procedures is outlined in easy-to-follow steps,
- working equations are presented for each type of fluid to be measured for both Simplified and Refined Calculations using the same fundamental symbols which appear in the Reports on Fluid Meters and Flow Measurements,
- tables, curves, and illustrative figures required for the solution of any flow measurement problem are given,
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Glassed Pumps

For highly corrosive pumping jobs involving relatively small capacities—up to 75 gpm, Goulds Pumps, Inc., now has available a 1-in. size Goulds-Pfaudler glassed pump. This unit will fill a demand in the chemical processing industries for a unit of lower capacities than available with the highly successful Model 3708 glassed pump.

Model 3706, 1 × 1 × 6-in. pump, has all the features of Model 3708 first placed on the market in 1956. Glass, fused to metal, on all surfaces coming in contact with the pumpage, provides almost universal resistance to corrosion, eliminates contamination of product and adherence of product to pump parts. The bonded glass is tough and all-glass surfaces are continuous with no bolt holes or tapped openings. A confined Teflon envelope gasket between casing and casing cover provides a corrosion-proof and leak-proof joint. With the quench gland and bearing cooling chamber, liquids up to 350 F can be handled.

Grease-lubricated ball bearings are standard with oil-lubricated bearing construction optional. The fully open type impeller is specially designed for glassing and has an extended hub which fully protects the stainless-steel shaft from the pumpage. The hub extends beyond the stuffing box gland eliminating any joint within the pump; always a possible source of leakage along the shaft. Details in Bulletin 725.3. **—K–31**

BUSINESS NOTES

Titanium Products Distributor

Wolverine Tube, Division of Calumet & Hecla, Inc., Allen Park, Mich., has announced the appointment of Williams and Co., Inc., Pittsburgh, Pa., as a distributor for its titanium and zirconium tube and rod. The company will handle the distribution of those products in five north-central states.

Williams and Co., a prominent metal distributing firm specializing in corrosion-resisting materials, maintains warehouses in Pittsburgh, Pa.; Cleveland, Cincinnati, Columbus, and Toledo, Ohio; and Louisville, Ky.

Wolverine Tube, widely recognized as a producer of copper, copper alloy and aluminum tubing, is now producing titanium, zirconium and other special metals in the Wolverine Special Metals Plant in Inkster, Mich.

Piping Materials

A complete "package" of corrosion-resistant piping materials is being made available as the result of a license recently awarded Babcock & Wilcox Co. to produce and sell welding fittings and flanges of Yoloy steel to match the Youngstown Sheet & Tube Co. piping of the same alloy.

Yoloy is an alloy which, according to an announcement by the two concerns, is lower in cost and resists corrosion better than wrought iron. It was developed by Youngstown, producers of seamless and continuous-weld Yoloy pipe. Babcock & Wilcox was selected to manufacture Yoloy fittings and other products because the welding fittings operation of its Tubular Products Div. is integrated with its steel and tube-making facilities, the report said.

LATEST CATALOGS

Digital Rotopulsers

Dynapar Corp., Subsidiary of Louis Allis Co., has published a four-page bulletin, No. 200-A, on digital rotopulsers. These instruments for precise industrial measurement and automatic control are available for requirements up to 2400 pulses per rotation. Designed for use with Dynapar process controllers, totalizers, add-subtract counters, draw indicators and special digital controls, they can also be used with many other types of readout and control devices.

The bulletin presents full information and application data on these transducers that convert motion into pulses. There are no calibration adjustments—no drift. They provide any required accuracy, transfer information over any distance without error and give direct numerical readout. **—K–32**

Heat Recirculator

Genie-Air Products, manufacturer of industrial-powered ventilators, describes the production of a heat recirculator, identified as Model HR, in Catalog No. 58-100. Heat normally trapped under the roof line is recovered and returned to the floor area. The motor-operated fan pulls heat into the top of the unit and diffuses it down through conical openings, obtaining maximum floor coverage. No holes are required in the roof; installation is simple; and it is applicable to new and old construction. Model HR is available in sizes from 280 to 30,000 cfm. Summer exhaust may be increased by suspending it under existing gravity ventilators and reversing rotation of motor through a selective control switch. **—K–33**

Production Facilities Offered

A 12-page brochure describing specialized production facilities available to manufacturers is being distributed by Danly Machine Specialties, Inc., maker of presses, die sets and diemakers' supplies.

The book describes Danly's welding, machining, assembly, engineering, and other facilities which have been utilized by the Atomic Energy Commission, Naval Ordnance Laboratory and National Aeronautics and Space Administration (NASA) as well as several other industries, large and small.

The company states that its Chicago plant is geared to handle a complete range of manufacturing jobs, from the production of small, precision parts and controls to the fabrication of machinery weighing hundreds of tons. The booklet illustrates some of the unusual jobs accomplished with the Danly facilities which carry the job from raw material to finished product. It also describes the company's full range of testing equipment and facilities for research and development. —K–34

Mechanical Differentials

Dynamic Gear Co. has announced publication of a brochure on precision mechanical differentials. In addition to general information on differentials and design criteria, the book, designated Brochure 8101, shows a group of stock and pre-engineered differential drawings. Also included is a test report on an actual stock differential.

A feature of the brochure is the special section, containing 27 drawings of stock and pre-engineered differentials. The drawings are printed on perforated pages, which can be detached from the publication and reproduced by ozalid or traced for use in conjunction with existing drawings. —K–35

Hydraulic Accumulators

Handbook CH-1 describes a complete line of patented Taylor hydraulic accumulators by Taylor Devices, Inc., specialist in molecular compressibility devices. These standard accumulators are the smallest in relation to capacity available. Lighter weight is also an inherent design feature owing to clean, compact design and a minimum of parts. Taylor accumulators are all liquid and are designed without gas bags and gases to eliminate possible leakage. Working liquid from the system can also be used. Integral control of flow and pressure meets precise requirements. High-production economies are effected by using the same precision component parts from the standard line of Taylor Liquid Spring Shoks. —K–36

Dust Collectors

Self-contained, air-pollution control equipment, developed for the control and collection of industrial dusts in metalworking, woodworking, and other operations, is described in Bulletin No. 230 issued by John Wood Co., Air Pollution Control Div.

The bulletin illustrates and describes functions and applications of selfcontained cyclone separators, fabric filters, and combination fabric/cyclone separators in low-volume systems. A feature of this equipment is the unique "building-block" construction. It extends installation and operation economy and application facility. —K–37

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Water Processing

American Sterilizer Co. offers a 32-page brochure, Bulletin IC-601 R, detailing water-distilling systems covering the range from ½ to 500 gph. Gas, electric and steam-heated units are available in single, double or triple-distilling systems. —K–38

Slip Clutch

An improved gear-type slip clutch, adjustable from zero to 50 in-oz torque has been announced by Northfield Precision Instrument Corp., in Catalog No. 461. The axial position of clamp sets the torque and locks the unit to the shaft. Precision engineered to MIL-E-5272 C, this unit is comprised of a stainless-steel spur gear, Delrin bearing and clutch plate, steel spring, anodized aluminum hub and clamp. The Delrin bearing and clutch plate are designed to achieve smooth torque transmission with a minimum change from preset torque value. —K–39

Hydraulic Filters

Tell-Tale (registered trademark of the Rosaen Co.) filters for suction-line use in hydraulic systems are described and illustrated in Bulletin 61-78, 4 pages, available from Vickers Inc., Div. of Sperry Rand Corp. An indicator on the outside of the filter shows clearly when cleaning is required and eventually indicates that the filter is bypassing if the warning is ignored. Circuit reliability is thus promoted since there is less dependence on the human factor. Mechanical indicator is standard; electrical indicators are available as options. Filter elements are available in degrees of filtration ranging from 74 to 238 microns and for flow rates from 0 to 120 gpm. Cleaning is particularly easy, requiring only two to three min.

The bulletin features a large cutaway drawing showing all major parts. Complete dimensional data are given on all models, and instructions for ordering are presented. Models with electrical indicators and magnetic filters are illustrated. —K–40

Heat Exchangers

The release of a Horizontal Cooler and Condenser Catalog, has been announced by the Young Radiator Co. The 16-page, two-color catalog contains complete information on horizontal core, air-cooled heat exchangers for the cooling and temperature control of oil, water and gases or for condensing vapors.

The revised copy describes the efficiency, economy and versatility of the units and illustrations of typical applications point out their durability. Design features are covered with a brief description of each. Accessory equipment is listed and various methods of cooling using HC (trademark) units are detailed in diagrams. Required information for recommending HC units and a unit nozzle selection chart are included. Dimensional drawings and specification data complete the catalog. —K–41

Rubber-Seated Gate Valves

An eight-page Bulletin 302 of DeZurik Corp. describes DeZurik rubber-seated, bonnetless knife gate valves. The bulletin lists features of the valve as well as materials, dimensions, actuators, and outlines the broad areas where the valve is used extensively. —K–42

Pressure Gages

Robertshaw-Fulton Controls Co. complete line of "Acragage" pressure gages is described in a revised sales folder, SF-761, issued by the Fulton Sylphon Div. Brief descriptions of the various case styles available for standard Acragage items, as well as for gages designed for specific services, are contained in the folder. Acragage pressue gages employ solid-front safety construction, with full area rear blow-out disks as standard. —K–43

Stress-Strain Gage

A unique bonded-resistance foil-type stress-strain gage is described in a product data sheet, No. 4323, published by Electronics & Instrumentation Div. of Baldwin-Lima-Hamilton Corp. The data sheet provides information on the use of the stress-strain gage as a simple and automatic computing device which solves stress-strain equations without complex calculations by the user.

The gage incorporates two separate axial strain-sensing elements oriented 90 deg apart so that it can develop an electrical response proportional to either stress or strain at the user's discretion. Each element may be observed independently for conventional strain measurement, or together to produce readings that are proportional to stress along the principal axis. A table shows temperature compensation, stress measurement and nominal resistance values for use with ordinary steel, most stainless grades or aluminum. A line drawing, which shows gage construction, is keyed to an explanation of theory and application of the unit. Suitable bonding agents for temperatures to 150 or 450 F are listed. —K–44

Molding Compound

Thermomat, an asbestos felt molding compound in sheet form, is described in a bulletin available from Johns-Manville. The bulletin, TX-10A, contains technical data, as well as describes successful application of the material to missile and rocket components requiring resistance to tremendous heat, pressure, and flame erosion.

Applications described in TX-10A include use of Thermomat in fabrication of flame shields, nose cones, and as a rocket-motor liners. The bulletin covers the physical characteristics of the noncured material which make it easy to work with and to produce acceptable fabrications. In addition, tabular data on cured laminates made from various styles of Thermomat are included, such as mechanical, thermal, and electrical properties. —K–45

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Switchgear

Design 4.16 and 13.8 kilovolt circuit breakers and switchgear, first in this rating developed specifically for stored-energy closing, are described in a bulletin published by I-T-E Circuit Breaker Co. The 40-page bulletin provides drawings, sketches, photographs, specifications and charts as an aid to designers, architects and application engineers of industrial companies, utilities, contractors and consulting engineering firms.

—K-46

Process Control Center

Bulletin 239.12A on the Rockwell-Republic unified process control center is available from Republic Flow Meters Co., Subsidiary of Rockwell Mfg. Co.

The four-page publication describes the company's compact equipment for combining readout and control functions with a 4-in. strip-chart recorder in a single panel assembly. Also included in the illustrated bulletin is a diagram providing installation data for the control center.

—K-47

Hydraulic Fluid

A four-page technical data sheet, Bulletin OP1397, gives complete details on Nalco Chemical Co. Fyre-Safe 225 hydraulic fluid. Pump test data are included as well as water makeup and viscosity temperature charts. Instructions for changing from petroleum oil to a fire-resistant, water-glycol hydraulic fluid are also outlined.

—K-48

Welding Fittings

Engineers, buyers and estimaters associated with steel piping will be interested in a data sheet recently published by Babcock & Wilcox Co. Tubular Products Div. The data sheet, designated TF-511, covers short-radius, double extra strong 90-deg elbows and 180-deg returns in a size range of $1^1/_2$ through 8 in. nominal pipe size.

The bulletin contains charts showing all pertinent elbow and return dimensions. Wall thicknesses are in accordance with ASA B36.10 specifications for double extra strong wall pipe. Dimensional tolerances are as per ASA B16.9.

—K-49

Valves

Bulletin HYD-1 of A. W. Cash Valve Mfg. Corp. covers specifications and descriptions of the Cash-Acme Hydrozone motorized zone valves, reducing valves for hydronic boilers, ASME pressure relief valves for hydronic boilers, and a complete series of dual controls.

Illustrations, cross sections and descriptive tables are given for easy reference.

—K-50

Whiteprinter

A four-page bulletin, describing and illustrating design and operating details of the latest model Streamliner 400, Ozalid's 42-in. capacity budget-priced whiteprinter, is available from Ozalid, Div. of General Aniline and Film Corp. The Streamliner 400 was designed to serve as the central unit in drafting rooms or engineering departments or for use in medium-volume reproduction shops. It includes engineering features specifically designed to give sharp, high-quality prints from any translucent original.

—K-51

Will they grow up in a free world? Would you want them to grow up in any other kind? The answer to that question is why millions of Americans regularly visit the Savings Bond window at their bank.

What 63¢ a day can mean to their future

. . . and Uncle Sam's

Investing 63¢ a day at 3¾% interest can bring some pretty nice things into your future. In six years—$1,500 down on a new home. In twelve years—nearly $3,500 for college costs.

But things being the way they are, it's pretty hard to consider your own future without giving some thought to your country's future, too. Millions of Americans have done this and are putting their savings into United States Savings Bonds.

The money you invest in Savings Bonds is one of the best ways you can help Uncle Sam today. It helps keep our economy strong and provides one of the most dependable means the Government has to manage the costs of national defense.

Buy a Bond today. You can lend your country a real hand now by saving this way for the future.

How U.S. Savings Bonds benefit you personally

1. You get 3¾% interest to maturity. **2.** Your Bonds are replaced free if lost. **3.** You get your money whenever you need it. **4.** You can save automatically where you work.

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Keep freedom in your future with

U.S. SAVINGS BONDS

This man says we're soft and shaky. An important part of our answer is our financial strength as individuals and as a nation.

This advertising is donated by The Advertising Council and this magazine.

Electrically Operate Your Plug Valves

IN 8 TO 16 SECONDS

...by Push-Button Controlled

LimiTorque ACTUATORS

SAVE MONEY, TIME AND LABOR

Yes, here's another LimiTorque *first*—simple, compact, positive acting, easily installed motorized operators for plug valves. They can be built to either NEMA IV (weather proof), or NEMA (explosion-proof) standards; and, requires no gear changes or other modifications, other than to supply a motor of the proper output speed. These new, unique units consist of motor and double reduction gearing, which drive a traveling screw and a crank that is easily mounted to the square shank of the plug valve. As can be seen from the illustration, the entire assembly can be readily adapted to the plug valve while in service, by merely mounting the crank on the plug shank, and strapping the support bracket to the pipe. The LimiTorque Linear Operator is supplied with all necessary adapting parts, such as the support bracket and straps for mounting on the pipeline and the necessary crank arms for mounting on the square shank of the valve. The entire construction and operation is simple and reliable—and the purchase price and installation costs are comparatively low.

A torque of 175# is developed at the valve, which is normally more than enough to drive most wrench-operated plug valves up to 6" in size. If power fails, or manual operation is desired, the mere removal of a pin (which connects the traveling screw to the crank arm) will divorce the crank from the Linear Operator assembly—and a bar placed in the bushed bore of the crank arm will operate the valve. (No special wrench is needed.) The mere flick of a switch to the direction of travel desired will operate the valve.

Contact your valve manufacturer, or your nearest LimiTorque Sales Engineering Office.

Full details on this new LimiTorque Linear Operator are contained in Bulletin 20-58 . . . send for copy on your business letterhead.

THERE IS NO SUBSTITUTE FOR —

LimiTorque®

PHILADELPHIA GEAR CORPORATION
KING OF PRUSSIA (SUBURBAN PHILADELPHIA), PA.
Offices in all Principal Cities

PRECISION GEARS • INDUSTRIAL GEARS • SPEED REDUCERS • FLUID MIXERS • FLEXIBLE COUPLINGS
Limitorque Corporation • King of Prussia, Penna.

Circle No. 104 on Readers' Service Card

1963
MECHANICAL ENGINEERS' CATALOG

INCREASED CIRCULATION, LOWER COSTS, MODERNIZED FORMAT FOR 1963 MECHANICAL ENGINEERS' CATALOG

The Mechanical Engineers' Catalog now features three major areas of improvement, of direct benefit to advertisers:

1. *Circulation Increased*

For the past several years, requests for the Mechanical Engineers' Catalog have been greater than the available number of copies. Beginning with the 1962 MEC, the ASME Publications Committee decided to increase the print run to meet the demand. This has resulted in a circulation increase, initially, to over 20,000 copies.

All 20,000 copies are sent, free, to members of the ASME and other qualified engineers who request the Mechanical Engineers' Catalog in writing. There has been no change in this policy. It assures MEC advertisers of pinpoint circulation to the mechanical-engineering market . . . to the engineers who specify or recommend products for their designs.

2. *Advertisers' Costs Lowered*

MEC rates for two-page inserts have been lowered by 18%, and four-page insert rates by almost 10%, effective with the 1963 Catalog. In addition, all contracts received prior to March 15, 1962, will be accorded to a 10% discount.

Catalog two- and four-page insert rates have been lowered to allow more companies to place more complete data about their products in the Catalog. This will result in increased Catalog usership by engineers. The 10% discount for early contracts is made possible by the fact that early production planning does save money, and some of the saving is thus being passed along to advertisers, as an inducement.

3. *Format Modernized*

The Mechanical Engineers' Catalog has had its face lifted. Modern typography and layout, and heavy, colored section dividers, are designed to make MEC easier for the engineer to use. In addition, the Catalog now has an ample, integral supply of information-request cards, for the engineer to use to obtain more data on advertised products.

FOR COMPLETE ADVERTISING INFORMATION
WRITE

MECHANICAL ENGINEERS' CATALOG

Published by the American Society of Mechanical Engineers
United Engineering Center
345 E. 47th St., New York 17, N. Y.

Aldrich pump helps put the bounce into A. G. Spalding products

This Aldrich triplex pump stands behind the bounce of famous Spalding golf balls, tennis balls, footballs, basketballs—all Spalding equipment containing rubber. The specific service of the pump is to provide hydraulic pressure for rubber molding and preforming presses. It is imperative, states the sporting goods manufacturer, that a high and constant pressure be maintained—2500 psi at 50 to 70 degrees F. This the pump has done reliably, and for nine years, operating on an average of 132 hours a week. From installation to the present time, concludes Spalding, overall performance of the Aldrich unit has been completely satisfactory.

Whether the fluid is water under high pressure or a corrosive chemical, there *is* an Aldrich pump to handle it. If your problem is more than somewhat special, be assured Aldrich engineers will come up with the very best answer, not one that will just "do". Pumps range from 5 to 2500 hp, and up to 50,000 psi, specials to 100,000 psi. If your project is right-now, check out our insert in Chemical Engineering Catalog, then get in touch with Aldrich Pump Company, 29 Pine Street, Allentown, Pennsylvania. Most fluid handling applications are easy, but remember that . . .

THE TOUGH PUMPING PROBLEMS GO TO

ALDRICH
SUBSIDIARY OF INGERSOLL-RAND

Circle No. 5 on Readers' Service Card

OPPORTUNITIES

positions open • positions wanted • equipment, material, patents, books, instruments, etc. wanted and for sale • representatives • sales agencies • business for sale • partnership • capital • manufacturing facilities

ANSWERS to box number advertisements should be addressed to given box number, care of "Mechanical Engineering," 345 East 47th St., New York 17, N. Y.

RATES: Classified advertisements under this heading in MECHANICAL ENGINEERING are inserted at the rate of $4.50 a line. $2.00 a line to members of ASME. Seven words to the line average. A box number address counts as one line. Minimum insertion charge, 5 line basis. Display advertisements carried in single column units of multiples of one inch at flat rate of $45.00 per inch per insertion. Copy must reach us not later than the 10th of the month preceding date of publication.

POSITIONS OPEN

DEVELOPMENT AND SALES ENGINEERS

VALVES and mechanisms for critical high-pressure, high-temperature services in the growing marine, petroleum, process and power fields—including nuclear power.

CONTACT R. A. Kampwirth, Edward Valves, Inc., subsidiary of Rockwell Manufacturing Company, 1200 W. 145 St., East Chicago, Indiana.

OVERSEAS

Robert College, in Istanbul, Turkey, presents a challenge in education where East meets West. An opportunity to contribute significantly to the development of a young republic is available to specialists in engineering, business administration and economics, the sciences, and the humanities. Graduate degrees required.

Address inquiries to **Dr. Howard P. Hall, Vice President, Robert College, Bebek Post Box 8, Istanbul, Turkey; with copy to the Near East College Association, 548 Fifth Avenue, New York 36, New York.**

ENGINEERS

PLANT and SENIOR ENGINEERS

A large non-defense, aggressive, expanding and stable firm needs capable and successful engineers for

CALIFORNIA LOCATIONS and ENGINEERING HEADQUARTERS

These vacancies result from promotions and rapid expansion.

The PLANT ENGINEER will direct the Plant Engineering Department, being responsible for maintaining optimum plant efficiency through engineering, design, equipment selection and working with plant supervision.

The SENIOR ENGINEER will be given assignments in developing and supervising engineering design for modification and expansion of plants, and for machinery applications.

Candidates must meet the following requirements.

1. BS in engineering.
2. At least 5 years of broad experience in plant or equipment application engineering in a processing or allied industry.
3. Fields of engineering experience desirable are pumping, conveying, material handling, piping, steam, electrical and instrumentation.
4. Under 42 years of age.
5. Supervisory experience is desirable.

This firm pays very competitive salaries and offers unusual opportunity for professional growth.

Please send complete resume, giving salary requirements and background, including age.

All replies will be kept strictly confidential.

Address CA-7257, care of "Mechanical Engineering."

ENGINEERS
LIVE IN DENVER
BUILD A CAREER

with

One of the oldest, largest & most progressive custom machine builders in the west.

We need a limited number of

MACHINE DESIGNERS

Who must have an engineering degree and at least 5 years' experience in the design and manufacture of custom made machinery employing heavy precision machined components, castings, and fabricated weldments.

Must be capable of performing basic stress analysis, preparing design layouts and design other components for manufacture including establishment of fits, tolerances, surface finishes, etc.

Experience with nuclear fuel handling equipment, nuclear shielding & heat transfer desirable but not mandatory.

Challenging projects for progressive engineers.

Liberal relocation assistance, extensive employee benefits.

Send resume, photo and work samples to

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DIRECTOR OF ENGINEERING

STEARNS-ROGER
(since 1885)
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P. O. Box 5888
Denver 17, Colo.

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Industrial sales experience, fluid mechanics background. Chemical feeders, proportioning pumps & metering equipment. These are responsible positions in assigned areas, various U.S. locations, involving technical sales and promotion with key accounts. Salary, expenses, company car. Submit resume indicating salary requirements.

Address CA-7228, care of "Mechanical Engineering."

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To work with small group engaged in creative mechanical design and development on automatic assembly equipment used in electronics industry. Prefer BS Mechanical Engineering and 2–6 years' experience in above or related light engineering field.

Expressions of interest may be addressed to Mr. Dick Williams, Employment Manager.

P. R. MALLORY & CO., INC.
3029 East Washington St.
Indianapolis 6, Indiana

Equal Opportunity Employer

BECHTEL

San Francisco

Power and Industrial Division offers immediate employment opportunities for electrical, mechanical, or structural engineers capable of assuming responsibility on design of major steam or hydro power plants.

Relocation allowances cover moving costs plus transportation reimbursement for you and members of your family. If you have an interest in a San Francisco assignment, please send a resume of experience to W. A. Anderson, Technical Recruiting. Personal interviews will be arranged for qualified candidates.

Bechtel
Corporation
220 Montgomery Street
San Francisco, Calif.

In New York City, a personal interview can be arranged by phoning Edmund J. Orr, MUrray Hill 7-7100

MECHANICAL ENGINEER

DEVELOPMENT

San Francisco Bay area. Outstanding opportunity with a promising future for an engineer capable of exercising ingenuity and creative thinking. Will assume full responsibility for complete projects in the design and development of special processes for the production and finishing of magnetic tape. Excellent salary, professional atmosphere, and company benefits in an ethical, highly respected organization. Send complete resume, including salary requirements to

F. S. Schlaepfer, Ampex Corporation
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Electrical, Mechanical or Chemical Engineering Graduates to be trained as Sales Engineers for Cleveland, New York, Chicago, and Richmond, Virginia. We also have an opening for man with technical background for inside office work at Los Angeles. Prefer men between 25 and 32 years of age who have had industrial process experience. Successful applicants will be given a three-month factory course starting February 1, 1962. **Write Harry E. Beane, Vice President, The Bristol Company, Waterbury 20, Connecticut.**

NCR

MECHANICAL DEVELOPMENT

The National Cash Register Company is currently seeking qualified Mechanical Engineers to augment its staff at its Research and Development Center in Dayton, Ohio. The following opportunities are typical of the level of work being done:

- **APPLIED MECHANICS:** Vibrations studies as related to computer and high speed mechanical equipment. Qualifications are MSME with major in applied mechanics and interest in working at a theoretical level.
- **ADVANCED DEVELOPMENT:** Work involves advanced design of electro-mechanical business machines related to large systems including magnetic tape computers. Preferred qualifications are at least a BSME with 3–5 years' experience in magnetic file systems, vibrations analysis and applied mechanics, and logical design.
- **MECHANICAL DESIGN ENGINEER:** Work involves electro-mechanical design for defense purposes. Requirements are BSME with 3–4 years' experience in small electro-mechanical component work. Applicants must be citizens and eligible for military security clearance.

To apply for these and other outstanding R & D opportunities with The National Cash Register Company, send a complete resume with your letter of application to: T. F. Wade, Technical Placement, The National Cash Register Company, Main and K Streets, Dayton 9, Ohio.

An equal opportunity employer.

Mechanical Engineer

Research & Development

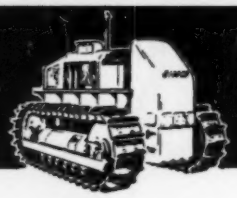
Immediate opportunity for a recent graduate in Mechanical Engineering to work with one of our Senior Research Scientists in structural design of new products involving fibers, resins, films and combinations of these materials.

This is a permanent position with one of the leading research organizations in the expanding field of nonwoven fabrics. Industrial experience not a requirement although a background in textiles, paper or plastics would be desirable.

Our laboratory is located near New Brunswick, New Jersey, 30 miles from New York, City. Opportunity for Company-supported educational program toward advanced degrees at nearby universities.

Please send a resume of your qualifications and salary requirements to: Dr. William S. Barnard

CHICOPEE
Manufacturing Corporation
Research Division
MILLTOWN, NEW JERSEY
A Johnson and Johnson Company



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Earthmoving experience, with successful record in design and development of heavy mechanical equipment, crawler tractors, bulldozers, winches and tractor attachments.

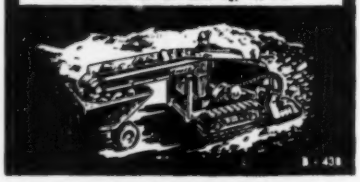
Work includes layout and design of heavy machinery for construction and mining.

Permanent positions open, for those qualified, with one of the nation's fastest growing heavy machinery manufacturers.

Location – Salt Lake City, Utah – in the mountain West, where you can breathe clean air, and drive from home to work in less than 20 minutes.

Send Complete Information and photograph to Dept. SX8

THE EIMCO CORPORATION
P. O. Box 300 Salt Lake City 10, Utah



B-438

POSITIONS OPEN

CREATIVE MECHANICAL ENGINEER-RESEARCH. Challenging opportunity with a leading manufacturer of air compressors and pumps. Recent graduate, B.S.M.E., Experience not required. Heavy on math, theory and ideas. Located in medium-size midwest community. Permanent position. Excellent benefit program. Write for further information and interview. Address CA-7261, care of "Mechanical Engineering."

ENGINEERS—College positions. All sections U.S. All fields of Engineering. Openings for B.S., M.S. & Ph.D.'s. Excellent salaries. Send qualifications to: Cline Teachers Agency, Box 607, East Lansing, Mich.

Registered HAV ENGINEER with at least 5 years' experience needed for permanent employment by Middle West consulting engineers. Excellent potential with growing firm. Please send resume, salary requirements and availability. Address CA-7212 care of "Mechanical Engineering."

FIELD ENGINEER. Permanent position for graduate mechanical engineer thoroughly experienced in all branches of industrial building construction. Moving expenses paid. Send complete resume. Address CA-7245, care of "Mechanical Engineering."

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POSITIONS WANTED

DOCTOR-ENGINEER, 30 (Germany, West-Berlin), 4 years' experience in research at Technical University Institute for Mechanical Engineering, lecturer, wants suitable position in U.S.A. Address CA-7236, care of "Mechanical Engineering."

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SALARIED PERSONNEL, $6,000 to $35,000. This nation-wide service successful since 1927 finds openings in your field. Sells your abilities: arranges contacts. Present position protected. Write for details—Jira Thayer Jennings, P. O. Box 674, Manchester, Vermont.

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SALARIED POSITIONS—$6,000 to $35,000. We offer the original personal employment service (established 50 years). Procedure of high standards individualized to your personal requirements. Identity covered. Particulars—R. W. Bixby, Inc., 662 Brisbane Bldg., Buffalo 3, N. Y.

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If you desire capital or have it to invest; if you have a patent for sale or development; if you have on hand used machinery for disposal, of if you want such equipment; if you have copies of publications, or a set of drawing instruments to dispose of; if you need help or want a position, in fact, anything to be offered that somebody else may want, or anything wanted that somebody else may have—

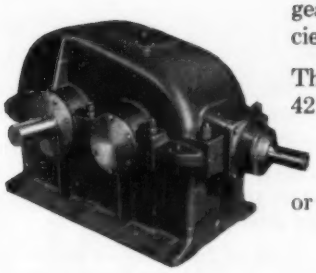
Use a Classified Advertisement
MECHANICAL ENGINEERING
for Quick Results

Answers to box number advertisements should be addressed to given box number, care of "Mechanical Engineering," 345 East 47th St., New York 17, N. Y.

for economy plus efficiency, use spiral bevel-helical reducers on your heavy drive applications

(Horizontal or vertical type)

Wherever your drive applications call for right-angle power transmission . . . heavy or shock loads . . . high reduction ratios . . . continuous operation, D. O. James *spiral bevel-helical* reducers are the answer. They provide economy of initial cost, economy of maintenance, and economy of operation. The very high efficiencies of spiral bevel gears and helical gears combine to provide an over-all reducer efficiency in the range of 95%.



These D. O. James reducers are manufactured in 42 standard sizes, .2 to 637 hp, 6:1 to 358:1 ratios.

For complete specifications and selection data, call your local D. O. James representative or write for Catalog No. 43-C.

D. O. JAMES GEAR MANUFACTURING CO. 461
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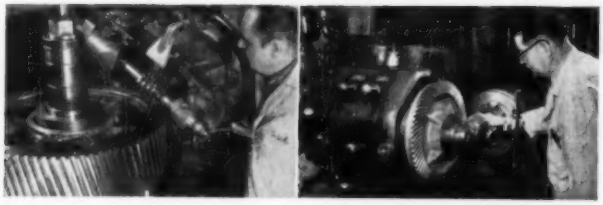
Since 1888, every type of gear and gear speed reducer



D.O.James

...where you always get good gearing

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Reports, Designs, Supervision of Construction
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JACKSON & MORELAND INTERNATIONAL, Inc.
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Electrical—Mechanical—Structural
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Consultants to the Power Industry
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Consultant
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Elizabeth, N. J.

PROPANE GAS PLANTS
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Designed and Installed
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Box 268, Westfield, N. J.

STANLEY ENGINEERING COMPANY
Consulting and Design Engineers
Muscatine, Iowa
Chicago — Cleveland — Washington
Monrovia, Liberia — Lagos, Nigeria

GAI GILBERT ASSOCIATES, INC.
Engineers and Consultants
Design and Supervision of Construction
Mechanical • Electrical • Nuclear
Sanitary • Chemical Laboratory
Business and Economic Research
New York **READING, PA.** Washington

An announcemnet in this

section will acquaint others

with your specialized practice.

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SVERDRUP & PARCEL
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Design • Construction Supervision
Steam and Hydroelectric Power Plants
Power Systems • Industrial Plants
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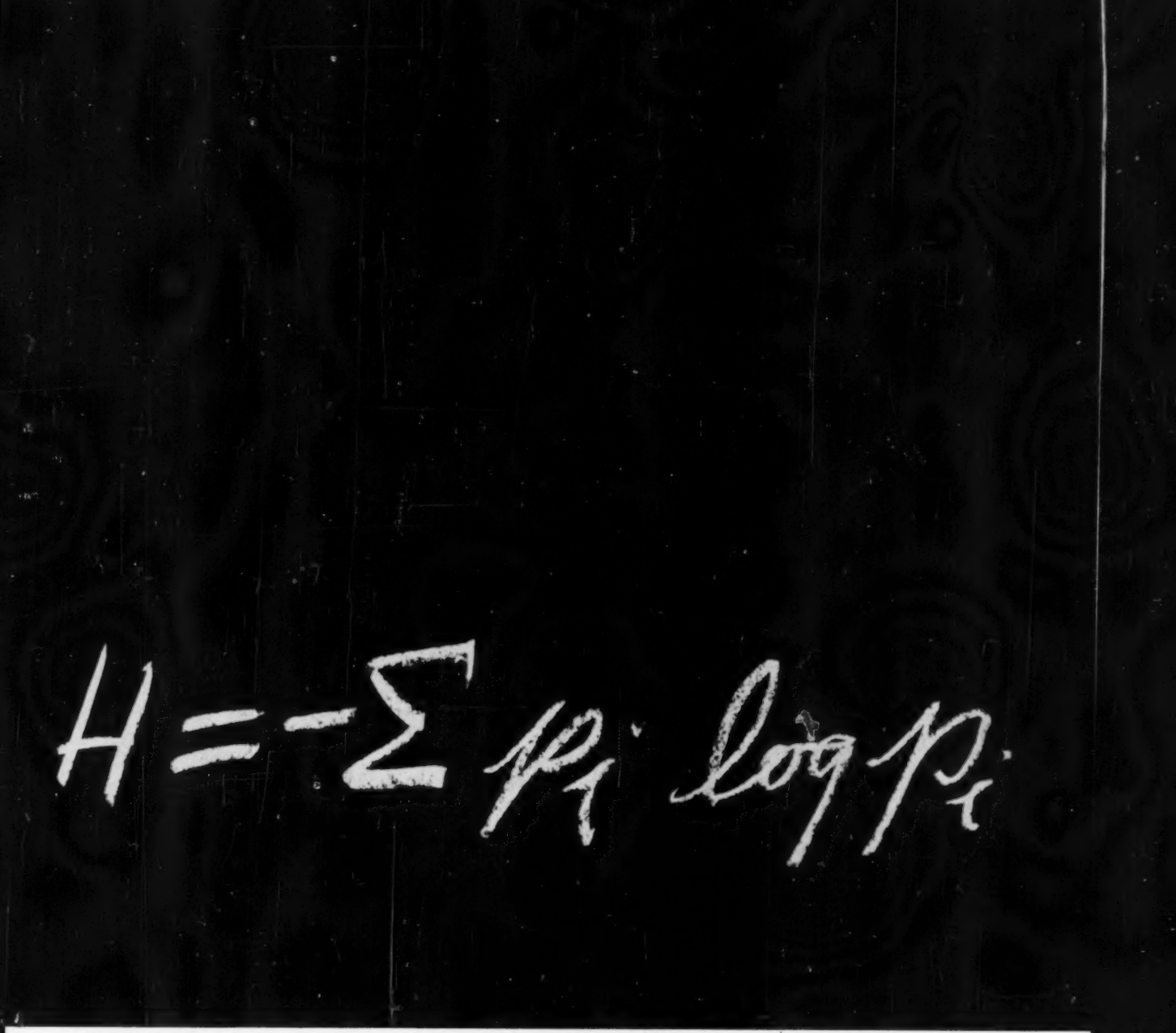

A basic formula from Information Theory . . . provides a measure of the amount of information in a particular type of message, such as TV . . . helps determine the frequency bandwidth, for example, required to transmit the messages. Information Theory, pioneered at Bell Laboratories, guides the search for better communications systems.

DISCOVERY

AT BELL TELEPHONE LABORATORIES

New knowledge comes in many forms. Sometimes it comes in a mathematical formula. Usually it comes after much thought and experiment and the fruitful interaction of different minds and abilities. Most often, too, a particular discovery is small. But many small discoveries have a way of leading to big advances at Bell Laboratories—advances like the transistor . . . or, more recently, the gaseous optical maser, forerunner of communications at optical frequencies. Opportunities for discovery are enhanced by the abilities of the scientists and engineers and the range of the facilities at Bell Laboratories, *world center of communications research and development.*

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* The asterisk indicates that firm has product catalog in the 1962 Mechanical Engineers' Catalog.

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Stock Equipment Co.
Stockham Valves & Fittings
Streeter-Amet Co.
Struthers Wells Corp.
Titusville Iron Works
*Syntron Co.

Titusville Iron Works Co.
Div. Struthers Wells Corp.
*Twin Disc Clutch Co.

Uni-Flex Mfg. & Engrg. Inc.
*Union Iron Works
Div. Riley Stoker Corp.
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W-K-M Division of ACF Industries, Inc.
Walden Kohinoor, Inc.
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Western Electric Co.
*Wickes Boiler Co.
Div. Wickes Corp.
Wiley, John & Sons
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Yoder Co.
York Corp.
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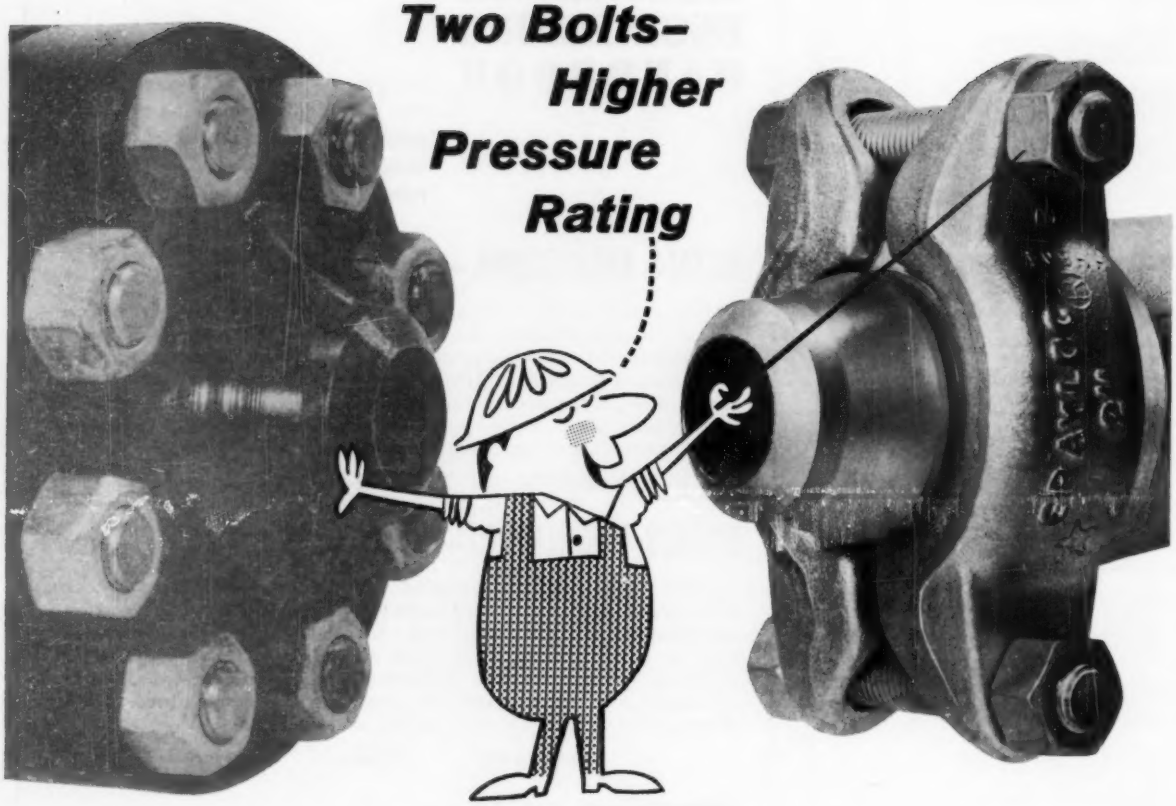
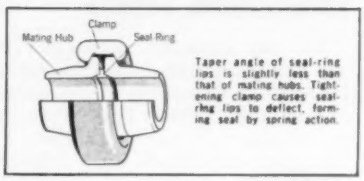
*Zallea Brothers

Only Two Bolts– Higher Pressure Rating





GRAYLOC® Pipe Connections can be assembled in less than 1/3 the time required for a comparable flanged assembly — yet GRAYLOC Connections provide as much as twice the maximum pressure rating.

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GRAYLOC Connections are manufactured in standard stock sizes from 1″ to 30″, with special sizes available on request. Highly corrosion resistant metals are available on short notice.

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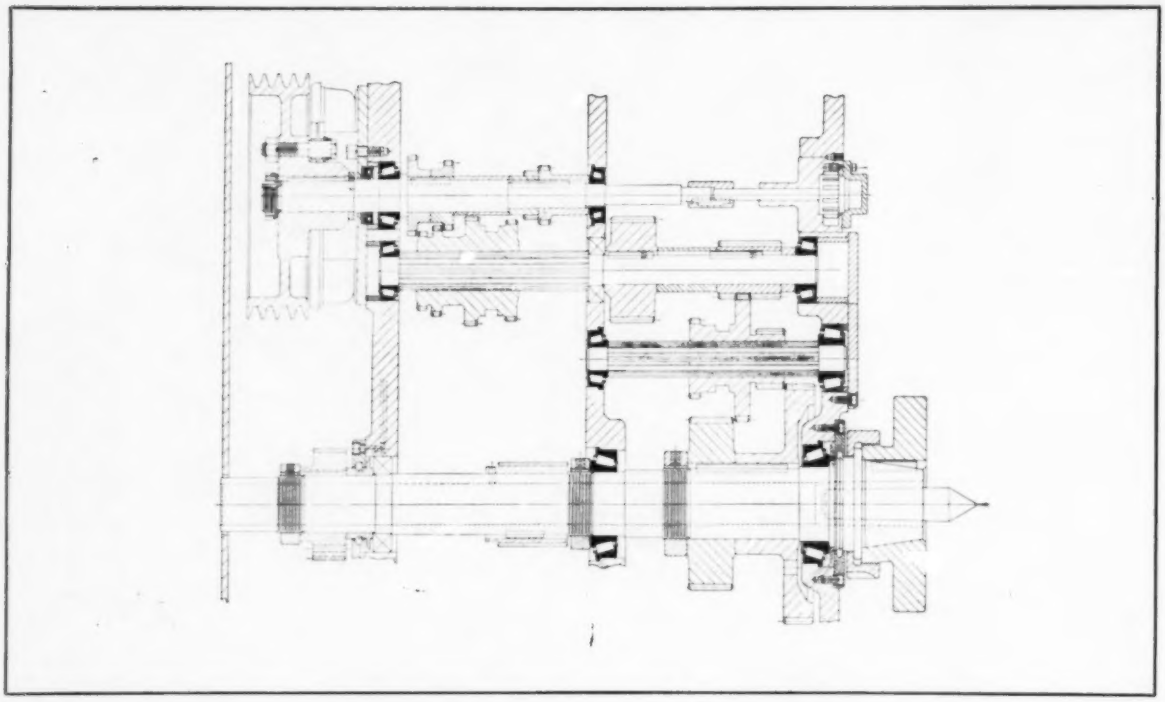
6111

LeBLOND lathe obtains super spindle-runout of less than .000025″ with Timken® "00" bearings



To raise the already great precision of its 15″ Dual-Drive lathe to a special new high for a customer, LeBlond had to meet this requirement: spherocity of the part to be turned—a beryllium gyro float assembly—had to be concentric with its two major axes within .0005″ total indicated runout. Diameter of the sphere: 1.8750″.

To assure this, LeBlond engineers specified Timken® super-precision "00" tapered roller bearings held to .000025″ assembled runout for the spindle—one-third the normal runout tolerance for these bearings. Timken bearings were also used on the intermediate, back and feed shafts of the drive. The assembled spindle runout (total indicator reading) was actually less than .000025″.

Producing super-precision bearings like this is typical of Timken Company service. The kind of service that developed Timken "00" bearings to meet industry's needs for ever-greater precision. It's another example of the Timken Company's leadership in tapered roller bearing design and manufacture.

YOUR BEARING PROBLEMS can often be solved on-the-spot by our graduate engineer salesmen. Working with you at the design stage, they can help you select the Timken bearing to meet your special needs, save you time and money.

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